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ABSTRACT

The purpose of this study was to acquire baseline data about students' environmental knowledge and attitudes and to study the relationships of attitudes and knowledge to variables that would be of interest in evaluative measures. Three forms of an inventory were developed to test knowledge of specific facts and general concepts of the environment, as well as attitudes about certain aspects of the environment. The inventories were administered to 10,264 students in 199 schoolslocated in 11 states of the mid-west and far-west. Results indicated that males scored significantly higher than females on items requiring knowledge of facts, but not on items dealing with general environmental concepts. Twelfth grade students scored significantly higher than tenth grade students on the environmental concept items, but not on the items requiring knowledge of environmental facts. In regard to attitudes, differences were found based on sex and grade level. The size of the community and the state of residence were found to be positively related to what was considered to be the major environmental concern in the community. Californian respondents selected air pollution, those in Wisconsin were more concerned with water pollution, and in Hawaii land use was considered to be of greatest importance. (JR)

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A SURVEY OF ENVIRONMENTAL KNOWLEDGE AND ATTITUDES OF TENTH AND TWELFTH GRADE STUDENTS FROM FIVE GREAT LAKES AND SIX FAR WESTERN STATES

By

Albert Cordell Perkes, Ph.D.

The Ohio State University, 1973

Professor Robert W. Howe, Adviser

The purpose of this study was to acquire baseline data about students' environmental knowledge and attitudes and to study the relationships of attitudes and knowledge to variables that would be of interest in evaluative measures.

The staff of the ERIC Clearinghouse for Science, Mathematics, and Environmental Education; and selected consultants developed three forms of an inventory which contained items requiring knowledge of specific facts and general concepts of the environment. Also, several items elicited students' attitudes about certain aspects of the environment.

The inventory was administered to a maximum of 30

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tenth grade students and 30 twelfth grade students from 199 schools which were randomly selected from the Great Lakes states of Illinois, Indiana, Michigan, Ohio, and Wisconsin; and the Far West states of Alaska, California, Hawaii, Nevada, Oregon, and Washington.

It was found that males scored significantly higher than females on items requiring knowledge of facts, but not on items dealing with general environmental concepts. Twelfth graders scored significantly higher than tenth graders on the environmental concept items, but not on the items requiring knowledge of environmental facts.

In regard to attitudes, differences were found based on sex and grade level. However, the calculation of a chi square statistic using proportions instead of the total number of cases indicated that proportional differences were slight.

The size of the community where respondents lived and went to school was not significantly related to knowledge of environmental facts and concepts, but was related to items requesting the respondent to identify what he thought to be the major environmental concern of the community. Using a forced choice technique, there was a

positive relationship between the size of community and the selection of pollution as the major community problem. However, this trend was reversed in cities over 100,000 population.

State of residence was also related to what was considered to be the major environmental concern in the community. California respondents selected air pollution; Wisconsin respondents were more concerned with water pollution; and respondents from Hawaii considered land use to be of major importance.

Due to the large student sample used in this study (10,264), few significant relationships should have gone undetected. Also, where no relationships were found, it is highly probable that replication would produce similar results.

A SURVEY OF ENVIRONMENTAL KNOWLEDGE AND ATTITUDES OF TENTH AND TWELFTH GRADE STUDENTS FROM FIVE GREAT LAKES AND SIX FAR WESTERN STATES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

Albert Cordell Perkes, B.S., M.A.

* * * * *

The Ohio State University
1973

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This work is the result of many individuals; directly or indirectly influencing the words written within or the thoughts and deeds preceding those words. Perhaps more important than the product itself, is the experience with a process. Those playing a role in that process were:

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The One who helps all, despite our weakness and lack of gratitude.

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CHAPTER I

INTRODUCTION

Introduction and Need for the Study

The existing quality of our biophysical environment is evidence that our problems have far exceeded our solutions. The deteriorating condition, directly or indirectly experienced by all, has been of such magnitude that many people have been influenced to reorient even basic values. For example, traditional economic goals of ever-increasing production have been questioned; environmental planks have been nailed into political platforms; the religious dogma of "multiply and replenish the earth" is being debated; and past educational objectives directed toward scientific and technological superiority are now being weighed in terms of potential threat or destruction of "the good life."

Compared to the sporadic and localized concern shown in the past, one outstanding characteristic of the new "environmental decade" is the ubiquitous nature of the movement. National concern exhibited by Earth Day showed that active and passive support by groups and individuals could be found at almost all organizational levels.

At the legislative level, environmental concern has led to the passage of several Congressional bills. Commitment has come from the executive branch as well. In his message to Congress, the President stated:

> Our environmental problems are very serious, indeed urgent, but they do not justify either panic or hysteria.... There must be a national commitment and a rational commitment. (Nixon, 1970, p. xiv)

The "environmental decade" has even reached international proportions. The realization that environmental interrelationships are complex and have far-reaching ramifications has substantially increased international concern and cooperation. In 1968 the United Nations General Assembly endorsed a Swedish proposal calling for a conference on the human environment. The conference, held in Stockholm in June, 1972, and attended by over 110 nations, focused international attention on the importance and urgency of environmental problems and recommended actions to cope with them.

Despite an apparent common interest to improve the quality of the environment, the solutions to present environmental problems are complicated by several technological and social facets; many of which are not yet understood. The President made this point in his Congressional Message...

> The problems are highly complex, and their resolution will require rational, systematic approach, hard work,

> and patience...In dealing with the environment, we must learn not how to master nature but how to master ourselves, our institutions, and our technology. We must achieve a new awareness of our dependence on our surroundings and on the natural systems which support all life, but awareness must be coupled with a full realization of our enormous capability to alter these surroundings. (Nixon, 1970, p. xiv)

These complexities of environmental interrelationships and decisions were also reflected in the National Environmental Policy Act of 1969 (1969). The act required that decision making incorporate environmental values along with technical and economic values that both short-and-long-term effects be given careful consideration and that irreversible actions and commitments be carefully weighed.

As the "new awareness" of the interrelationships of man and his world has emerged, the scope of "the environment," in many cases, has widened to subsume earlier specialities such as "conservation," "nature study," and "outdoor education." The resultant philosophy has, therefore, attempted to inculcate objectives from these several disciplines into some unifying themes. In most cases, a man-centered model has arisen. As stated by Schoenfeld:

> Whereas yesterday we tended to treat soil conservation, water conservation and so on as separate units, today we try to understand and explain the ecological unity of all man-land relationships. In terms of its focus, then, the new environment is man-centered... At the same time we are not so much

> concerned about quantities of natural resources as we are about the quality of the human experience. (Schoenfeld, 1970, p. 61)

This philosophy greatly enlarges the past ideas represented by Pinchot (1910) that environmentalism meant resource management with the intent for economic development for the infinite goodness of American progress; and Muir's (1906) view of the environment in esthetic terms.

Faced with the ever-broadening definition of "the environment," Lucas (1972) has recently attempted to identify and specify parameters for environmental education. He concluded that such education "about the environment," "for the (preservation of) environment," and the teaching strategy of education "in the environment" all may have legitimate claims to environmental education.

The present disagreements regarding the breadth of "environmental science" may effect the environment education curriculum, but they have not altered the responsibilities of our educational institutions in ameliorating environmental wrongs. The President in the Introduction to the First Annual Report of the Council on Environmental Quality, emphasized that...

> We must seek nothing less than a basic reform in the way society looks at problems and makes decisions...Our educational system has a key role to play in bringing about this reform... It is also vital that our entire society develop a new understanding and

> a new awareness of man's relationship to his environment--what might be called 'environmental literacy.' This will require the development and teaching of environmental concepts at every point in the educational process. (Nixon, 1970, p. vii)

Another major piece of legislation which has been recently passed to aid in the implementation of environmental policy was the Environmental Education Act of 1970 (1970). In its enactment, Congress made the assumption that the educational process was the only way to develop environmental understanding and commitment.

Recent surveys of curriculum offerings have shown the widespread agreement that environmental education objectives lie within the domain of the school. Maben (1971), in a survey of elementary school principals in the Great Lakes and Far West regions, found that 80 percent of responding principals in the Great Lakes region and 89 percent of those responding from the Far West offered instruction in what they called environmental or conservation education. Chin (1971), sampling the secondary schools in the same regions found that 55 percent of the Great Lakes and 68 percent of the Far West respondents offered environmental or conservation education.

Exactly how environmental education is to be implemented in the curriculum is subject to more diverse opinion. In a recent survey of school systems offering some sort of environmental education, the American Association for Health,

Physical Education, and Recreation (AAHPER) (1970) concluded that there was no single type of environmental education program. It was found that the programs existed in all grades, ranging from prekindergarten through adult education.

In Chin's survey, diversity of programs was also evident. It was found that 44.6 percent of the schools taught conservation or environmental education with science, 13.5 percent taught it with social science, 9.4 percent had instituted a separate course, and 11 percent were teaching it in two or more subjects, including science.

Despite the apparent acceptance of environmental education within the schools, it was found in the AAHPER survey that most programs were operated chiefly within the framework of the traditional academic curriculum with a primary focus on the technical and scientific aspects of environmental study (National Education Association Research Division, 1970). This approach corresponds to Lucas' (1972) category of education "about the environment."

This somewhat traditional implementation of environmental education has been criticized by Underwood (1971), Evans (1971), Knapp (1971), and Reid (1971) as being based too narrowly on conservation education.

In comparing the "theory" of environmental education with what has been taught in the schools, lack of correspondence is quickly evident. Philosophers concur that

worthy environmental education objectives must eventually deal with behavioral change. As Swan (1969b) has stated, many of our environmental problems are actually problems of human behavior, rather than problems of technology. The basis for his assumption is that technology for solving a major portion of today's environmental problems has been known for some time, but it has not been implemented. Ames (1971, p. 94) summarized this position in stating that "... in the final analysis the success of environmental education will be measured in terms of its ability to change the behavior of society."

Just how behavioral change is to be accomplished is the point of conjecture. The most commonly stated view is that expressed by Stapp et al. (1969). He proposed that if the child acquires particular broad environmental understanding (knowledge), he will develop a social conscience (attitudes), that will affect his behavior (actions) toward the total environment. In other words,

> if environmental education is to achieve its greatest impact, it must (1) provide factual information that will lead to understanding of the total biophysical environment, (2) develop a concern for environmental quality that will motivate citizens to work toward solutions to biophysical environmental problems; and (3) inform citizens as to how they can play an effective role in achieving the goals derived from their attitudes. (Stapp et al. 1969, p. 30)

However, those using environmental education models,

as proposed by Stapp et al. and discussed by Lucas (1972) which contain attitudinal and behavioral components, may find it convenient to make judgements about which attitudes and behaviors are to be taught. These narrow preconceived directions of environmental attitudes and behaviors are apparent in the teacher's role as described by Gratz:

> Teachers have the responsibility to help inform students about the crises in the environment...The student's way of thinking must also be developed to make it readily apparent to him that an extremely serious threat is involved--a threat that calls for action and sacrifice on his part. (Gratz, 1971, p. 73)

Such a direct influence upon attitudes and behaviors is not without its critics. Morgan (1970) stated that to deliberately develop a specific attitude towards a certain environmental problem is not a proper role of our educational system. Instead, he advocates producing generally informed, intellectually capable, socially concerned individuals capable of making rational objective judgements for themselves, and that those concerns and judgements are not to be preconceived. Hendee (1971) also objected to changing values according to what we believe is best. He further stated:

> Although some might argue that current crises conditions justify focusing environmental education on the changing of attitudes, such an approach can only lead to polarized opinions and, ultimately, compromised facts and rationality.

> It sells short the notion that current environmental concerns rest on well-reasoned arguments and intelligent objective analysis. (Hendee, 1971, unnumbered cover page)

Realizing the issue revolving around the specificity and intensity of attitudes and behaviors which are to be taught, the Department of Health, Education and Welfare, in a publication, Environmental Education: Education That Cannot Wait, issued the following directive:

> (1) Educational activity must work within the framework of local democratic government, which has as its tenet the freedom of individual choice and respect for the individual person.
>
> (2) Efforts in environmental education will not be dogmatic with respect to existing social or religious values--or coerce behavior--but will offer alternatives. (Department of Health, Education, Welfare, 1970, p. 13)

The apprehension to directly influence specific attitudes and behaviors is further compounded by the lack of understanding of just how attitudes and behaviors are related and how both influence or are influenced by the acquisition of knowledge. Even though several years of research have attempted to clarify these relationships, most present environmental education programs reflect the philosophy that unfavorable environmental behaviors are a result of unfavorable environmental attitudes. Most often, the method implemented to change these attitudes is the dissemination of "correct environmental knowledge." However, research cannot

yet substantiate this assertion.

The Problem

Many localized environmental education programs have realized the importance of attitude evaluation along with that of the cognitive domain. But the success of these programs in achieving knowledge and attitudinal goals may be questioned due the absence of national baseline data whereby such programs could be compared. Therefore, curricular decisions could be based on safer grounds than philosophical inclinations if data were available which measured present environmental knowledge and attitudes of a national sample.

A determination of what manipulatable and nonmanipulatable variables are related to desired knowledge and attitudes would contribute to the evaluation. For example, if favorable environmental attitudes could be positively related to grade level or to locations where environmental education programs had stressed attitudinal change, there would be some basis for concluding that such programs have merit. Likewise, those programs which measure success in terms of gains in environmental knowledge would be strengthened if knowledge of the environment could be positively related to grade level or location of the school.

However, if such relationships are not found to exist, many programs attempting to alter attitudes and knowledge about the environment would be subject to serious

re-evaluation.

Since assessment of environmental education programs have suffered from lack of national norms, the investigator has attempted to partially remedy the situation by seeking answers to the following questions:

(1) What is the environmental knowledge level of the sample of tenth and twelfth grade students from the Great Lakes and Far West states?

(2) What are the environmental attitudes of the sample of tenth and twelfth grade students from the Great Lakes and Far West states?

(3) Is environmental knowledge level related to sex, grade level, and size of the community where the school and home are located?

(4) Are there differences in environmental attitudes based on sex, grade level, state of residence, and size of the community where the school and home are located?

To answer the first two questions, frequency counts and percentages of responses will be determined with the aid of the BEACH computer program developed at The Ohio State University. Relationships pertinent to Questions 3 and 4 will be computed using the correlational program, BMD02D, developed by the Health Sciences Computer Facility, University of California at Los Angeles (UCLA, 1970), and the chi square program developed by Nie, Bent, and Hull (1970).

The following null hypotheses will be tested:

(1) There are no significant relationships between environmental knowledge level and sex.

(2) There are no significant relationships between environmental knowledge level and grade level.

(3) There are no significant relationships between environmental knowledge level and the size of the community where the school is located.

(4) There are no significant relationships between environmental knowledge level and the size of the community where the student lives.

(5) There are no significant differences in environmental attitudes based on sex.

(6) There are no significant differences in environmental attitudes based on grade level.

(7) There are no significant differences in environmental attitudes based on state of residence.

(8) There are no significant differences in environmental attitudes based on the size of the community where the school is located.

(9) There are no significant differences in environmental attitudes based on the size of the community where the student lives.

Definition of Terms

1. Environmental attitude--an inferred factor within the individual which involves a tendency to perceive and react in a particular manner toward some aspect of his environment (Davis, 1964).
2. Environmental education programs--any program of education for or in the outdoors; man and his relationship to his cultural, natural, and physical environment; development of environmental awareness and ethics; rational utilization of our environment; conservation of our natural resources; pollution control education; or nature study and interpretation (AAHPER, 1970).

3. Environmental knowledge--facts, concepts, and principles necessary for the explanation, understanding, or prediction of enviornmental phenomena.
4. Great Lakes region--includes the states of Illinois, Indiana, Michigan, Ohio, and Wisconsin.
5. Far West region--includes the states of Alaska, California, Hawaii, Nevada, Oregon, and Washington.
6. Public secondary school--an educational institution operated on public funds under the principal or head teacher, including any combination of grade levels from seven through twelve, except any lower grades under an elementary school organization.

Assumptions

Assumptions relating to this study were:

1. There was a need to obtain accurate, reliable, and relevant information about environmental knowledge and attitudes of tenth and twelfth grade students in the Great Lakes and Far West regions of the United States.
2. A descriptive survey using mailed inventories was the most practical means to obtain the needed information.
3. The sample of tenth and twelfth grade students was representative of the population of tenth and twelfth grade students in the public high schools in the Great Lakes and Far West regions of the United States.

4. The period of January 15, 1973-May 15, 1973 constituted a reasonable time span for the collection of data for the study.
5. The instruments used in this study were sufficiently broad to obtain useful data concerning environmental knowledge.
6. The instruments used in this study obtained valid indications of students' environmental attitudes.

Delimitations

The following are considered to be delimitations of this study:

1. The population of school districts consisted of only those school districts in the Great Lakes and Far West regions as listed in the Education Directory, 1968-69: Part 2-Public School Systems (1968).
2. The public secondary schools within school districts were limited to those listed in the respective state education directories.
3. The United States total student enrollment data and the individual state enrollment data used to determine the number of public secondary schools sampled per state, were limited to those given in Fall 1968 Statistics of Public Elementary and Secondary Day Schools (Barr and Foster, 1969).
4. The student enrollment data for school districts used

to determine the number of public secondary schools sampled per county or combination of counties were limited to those given in the Education Directory, 1968-69; Part 2-Public School Systems (1968).

5. The purpose of this study was not to evaluate environmental education programs, but to gather data on environmental knowledge and attitudes which may eventually serve as a baseline for future evaluative measures.
6. Conclusions drawn from this study are based on a sample of 199 secondary schools.

Design of the Study

This study used an inventory developed by the ERIC Clearinghouse for Science, Mathematics, and Environmental Education and the Center for Science and Mathematics Education at The Ohio State University and selected consultants. The inventory was developed to eventually assess knowledge of environmental facts and concepts and environmental attitudes of a multi-stage random sample of secondary students in all states and the District of Columbia.

Each form of the inventory consisted of a total of 39-40 knowledge and attitude items. Some items were unique to one form, while other items were found on two or all three forms of the inventory. Each form was administered to one-third of the sample students in each sample school.

The number of sample schools selected from each state was calculated on the basis of the ratio of total state secondary school enrollment to the total United States secondary school enrollment. Comparable steps at the county level determined the number of schools in the county selected for inclusion in the study. Individual schools were then randomly selected from an alphabetical listing of schools in the respective counties.

The initial contact requesting school participation was made to the principals of the selected secondary schools during the period of December 10-December 20, 1972. Follow-up correspondence was conducted with nonrespondents and those willing to participate but not returning the completed answer sheets. For those requesting that approval be obtained from someone other than the principal, the appropriate official was contacted.

Samples of up to 30 tenth grade students and 30 twelfth grade students were selected in each of the sample schools. Depending on the discretion of the principal, students were either selected randomly from alphabetical enrollment listings, or as members of a representative class.

Responses to environmental knowledge and attitude items were recorded on machine scoreable answer sheets and were transferred automatically to computer cards for analysis and summary by standard computer programs.

Analyses of data were carried out using descriptive,

correlational, and chi square statistics. Procedures used included a frequency count and percentage program (BEACH), developed at The Ohio State University; a correlational program (BMD02D), developed by the Health Science Computer Facility at the University of California at Los Angeles; and a chi square program, developed by Nie, Bent, and Hull (1970).

Overview

The dissertation is organized into five chapters:

Chapter I: Introduction and need for the study

Chapter II: Review of the literature containing research pertaining to behavior, attitude, and knowledge relationships. Also included are recent studies dealing with environmental knowledge and attitudes.

Chapter III: Design of the study including sampling techniques, instrumentation, data collection procedures, and a description the data analyses.

Chapter IV: Results and discussion containing descriptive analyses of the data, correlational analyses of the knowledge and attitude variables.

Chapter V: Summary, conclusions and implications, and recommendations.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Most educators agree that eventual positive changes in behavior is the goal of our present educational institutions. Within the realm of environmental education, behavioral change is especially important since environmental problems are considered to be a direct result of unwise actions. For example, under present electrical power potential, the solution to the problem of power shortage produced during times of maximum air conditioner use would require a definite behavioral change. Also, problems of recycling of solid wastes could be greatly reduced if trash were sorted by each household.

These examples serve to demonstrate that behavioral change is the criterion whereby environmental education programs must eventually be evaluated.

Behavioral Change

Behavioral change is facilitated through various methods, many of which are practiced to an extent in our

present society and its institutions of education. Perhaps the most extreme of these methods would be to remove the free agency of the public to choose alternative actions. As an illustration, supposedly after the year 1976, the public will have no alternative choice in purchasing a "non-polluting" or "polluting" automobile. Likewise, if a monopoly controlled the production of an essential item, the consumer has no choice in his purchase.

Such changes in the availability of goods and services, therefore, essentially remove the opportunity of decision-making. However, the existence of alternative actions is the basis of a society of individuals; an ideal which is widely accepted. Hence, in the schools, removal of action choices would not be philosophically esteemed.

Closely related to the removal of alternative action choices is the attachment of negative reinforcements to those actions which do not coincide with the public good. Such a method, used widely, initiates governmental regulations and laws based on the undesirability of associated penalties. Such laws are necessary for the protection of society and its environment from the ubiquitous offender and would not be needed if undesirable behavior was not present. In this case the individual does have a choice of breaking or sustaining the law, but out of fear of punishment his behavior is controlled. When this fear no longer exists, laws are violated. Since environmental behaviors are difficult

to supervise and this supervision is subject to moral implications, an environmental education program designed to alter behaviors through negative reinforcement is not usually acceptable as a preferred approach.

A more positive means for changing behavior, one used and accepted quite widely in education, is through external positive reinforcement. However, this approach might be designated as "coercion" and manipulation of behavior and the expectation of external rewards seems to most as a pedagogically inferior mode of education. Again, rational judgement and decision-making is not emphasized in this behavioristic learning model.

The most pedagogically pleasing route by which behavior may be changed is when it can be pre-empted by a change in attitude. This mode assumes that behavior is a logical consequence of an attitude or interaction of attitudes. Even though some researchers have been able to find evidence to support the assumption of a relationship between behaviors and attitudes, others have found difficulty in determining the nature of these relationships.

In a unique study attempting to relate behavior and attitudes, DeFleur and Westie (1958) obtained measures of attitudes toward Negroes from 250 college students. A situation was constructed in which it was believable to ask each of them to sign an authorization permitting use of a photograph of himself sitting with a Negro. The subject

was free not to permit the photograph to be taken at all, or, if he signed the authorization, to permit any of a number of possible uses of the photograph ranging from a very limited use in laboratory experiments to, at the other extreme, use in a nation-wide publicity campaign. An examination of the data revealed that there was a relationship between attitude and behavior. Those who were prejudiced were less willing to have the photograph taken and widely used.

Blatt (1969) in a similar study attempted to find discrepancies between private verbalized attitudes and overt behavioral attitude responses. In the verbal response treatment, subjects received a questionnaire containing the attitude items and the commitment levels. In the overt behavior treatment, the same subjects were interviewed on a taped radio show. During the interview the subjects were asked to respond to the same attitude items presented in the quesionnaire. At the end of the taping session, each subject was asked to sign a release statement similar to the commitments levels in the questionnaire.

The results showed there was no significant difference between verbal and overt behavioral responses on the attitude scale for either smoking marijuana or movie censorship. Also, there were no significant differences between verbal and overt behavioral responses on the commitment levels for either high or low social dependent groups. No significant interaction between the social issue and the level of social

dependency was indicated.

Contrasting results were obtained by LaPiere (1934) in a classic experiment. For two years the researcher traveled extensively with a Chinese couple, and in only one of 251 instances in which they purchased goods or services necessitating intimate human relationships did the fact that two were Chinese affect the group. But in a questionnaire sent to the establishments six months later asking if they would accept Chinese as guests, 92 percent of the restaurants and cafes, and 91 percent of hotels, auto-camps, and tourist homes replied negatively. The remainder replied that they were uncertain, depending on the circumstances. Questionnaires were also sent to hotels and restaurants not visited by the Oriental couple. The results showed that previous experience with Chinese had no important bearing upon the symbolic response to symbolic situations.

A more recent study by Kutner, Wilkins, and Yarrow (1952) supported LaPiere's results of inconsistencies between action and stated attitudes. Initially, two white women entered restaurants in a Northeastern suburb and were later joined by a Negro woman who said she was with a party already seated. In no instance was anything but examplary service accorded the group. Two weeks later, a letter was sent to the managers of each of the 11 restaurants requesting a reservation for a party which would be attended by some Negroes. Seventeen days later when no replies had been

received, each manager was telephoned inquiring of the letter and another attempt to make a reservation was made. The majority of the managers wished to avoid, if possible, having any Negro patrons but they did not wish to give a categorical "no" to the request. To avoid the possibility of a charge of discrimination, they tried to dissuade the caller from coming to their restaurant. Hence, discriminatory treatment seemed to be minimized when challenged in a direct face-to-face situation, but indirect evidence of discriminatory behavior appeared when a direct non-face-to-face challenge was made.

In other words, there are inconsistencies between verbally expressed attitudes toward Negroes and actual behavior relevant to those attitudes. This is supported by Riesman and Glazer's (1948-49, p. 40) conclusion that "for most people in modern society, there is no direct relationship between responsibility for having an opinion and responsibility for action."

Supporting this position are studies by Maccoby et al. (1962), Fleishman, Harris, and Burtt (1955), and Janis and Feshbach (1953). In each of these studies an attempt to change an attitude was successful as determined by attitude tests. However, this change was not followed by the expected behavioral change. On the contrary, behavioral changes were in the direction opposite of that expected. Festinger (1964), in speculating from these results,

contended that in order to produce a stable behavior change following opinion change, an environmental change must also be produced which will support the new opinion and the new behavior. Otherwise, the same factors that produced the initial opinion and the behavior would continue to operate to nullify the effect of the opinion change.

In the environmental problems area, results of studies attempting to relate attitudes to behavior have been comparable to those in social psychology. For instance, Strong (1970) referred to a case where 95 percent of the respondents to an environmental questionnaire expressed the attitude that the environment was "important" or "very important." On the basis of these results, it seemed reasonable to hope that, given an opportunity to assume wise land use throughout a small watershed, the residents would endorse a moderate degree of local governmental control and would forego the possibility for speculative gain on part of the land. Support for clean and ample water, for preserving the beauty of the countryside, and for fertile farms and fine fishing was nearly unanimous. No one wanted subdivisions, trailers, shopping centers, or factories next door or down the road. But many, or maybe most, would want them on their own land, if the price was right.

Because of such serious incongruencies between behaviors and attitudes, Tumin, Barton, and Burrus (1958) advocate the position that behavior should be directly modified,

without necessarily altering prejudices. This is based on their research reporting that prejudice is scarcely amenable to influence through rational evidence, nor can emotional re-education be considered a feasible alternative. However, such a conclusion becomes very difficult to implement as an educational objective.

Summarizing the available evidence testing the assumption that verbal responses reflect behavioral tendencies, Tittle and Hill (1967) stated that no conclusion can be reached with a satisfactory degree of confidence. They do conclude, however, that the degree of correspondence between attitudes and behavioral tendencies is at least a function of (a) the measurement techniques employed, (b) the degree to which the criterion behavior constitutes action within the individual's common range of experience, and (c) the degree to which the criterion behavior represents a repetitive behavioral configuration.

Since environmental education must be eventually concerned with behavioral change, several modes for accomplishing this objective have been discussed. The removal of alternative choices is currently being implemented to affect a change in behavior. Externally administered positive and negative reinforcements are also being used as a change agent. Even though our educational and political systems frown upon such methods, it can be argued, in relation to present environmental problems, that the critical situation

justifies such a means.

It is generally agreed that behavioral change should be pre-empted by a change in attitudes; that attitudes are reflected in behavior; and that attitude change should result from rational decision-making. But it has been shown that such a simplistic correspondence does not exist. Many presently investigated and uninvestigated variables must be considered in any formula attempting to use attitudes to predict behavior and behavioral change.

In environmental concerns, where objectives of behavioral change may not be manifest for several years, many behavioral-attitude variables may not be investigated except in controlled longitudinal research. Therefore, the evaluation of programs attempting to alter behavior through attitude change probably cannot be quickly accomplished.

ATTITUDES

In the literature the conclusions drawn from behavior-attitude complexities have been numerous. Contributing greatly to the variety of interpretations has been the disagreement as to the nature of an "attitude." Definitions of attitudes have been almost as plentiful as attitudinal studies. In reviewing the available definitions, Davis (1964) noted that nearly all seemed to have at least two factors in common:

(a) attitude is an inferred entity, something

which is not measured directly but rather deduced from other observable data.

(b) attitudes imply some sort of tendency to act toward the object for which they are held. (Davis, 1964, p. 8-9)

The measurement of this inferred factor is also cause for much confusion in the field. For example, the most common method of ascertaining an attitude is by means of an overt response--an opinion, either verbal or written. Whether this response is an indication of a private attitude depends on the interpreter. Remmers (1954) states that an opinion is simply "an expressed attitude." Davis (1964, p. 9), on the other hand, accepts a relationship between opinions and attitudes but separates the two on several points: "Opinions are more on the surface and more readily verbalized, whereas attitudes are deeper lying, more ego-involved general reaction tendencies."

Such a confusion of terms is understandable since the concepts of opinion and attitude are sometimes used interchangeably in the literature (Abelson, 1959).

Researchers and philosophers have also attempted to divide attitudes into various components. In analyzing the psychological processes which are involved in attitudes, a distinction is often made in terms of their cognitive, affective, and conative components (Krech and Crutchfield, 1948; Chein, 1951). In this case the cognitive component of social attitudes includes the perceptions, beliefs, and

expectations that the individual holds with respect to members of various social groups. The affective component refers to the fact that, in addition to beliefs about particular groups, such attitudes usually entail feelings toward these groups as well. The conative aspect refers to the fact that, in addition to thinking and feeling a certain way about a social group, there is usually a policy orientation, i.e. a tendency to react in a particular way toward members of this group.

Rokeach (1968) views attitudes as being composed of basically two components: attitude toward the object and attitude toward the situation. The expression of the attitude will vary adaptively as the attitude activated by the situation varies, with the attitude toward the situation facilitating or inhibiting the expression of the attitude toward the object, and vice versa.

It is not within the scope of this dissertation to further confuse the attitude controversy. The term "attitude" as used in this study will mean whatever is measured by paper and pencil tests which are commonly designated in the literature as "attitude tests."

ATTITUDE CHANGE

It has long been accepted that one of the objectives of the educational process is that of attitude change. Voluminous research has been conducted to determine if attitudes

can be changed, and if so, what variables influence that change. In general, attitude change has been found to be influenced by communicator characteristics, communication characteristics, situation variables, and variables dealing with individuals whose attitudes are to be changed.

An important contribution dealing with the relationship between personality variables of the one whose attitudes are to be changed and social attitudes, in terms of its influence upon subsequent research, has been The Authoritarian Personality, by Adorno, et al (1950). Reported in the publication is that individuals who are "high scorers" on scales of ethnic prejudice tend also to be characterized by such traits as authoritarian submission, conventionalism, rigid and stereotyped thinking, lack of insight, over-concern with power, over-identification with the "in-group," repressed hostility, displacement of hostility on to "out-groups," projection of unacceptable impulses on to others, etc.

In an experimental investigation designed to test the hypothesis of a relationship between attitude change and authoritarian personality, Wagmann (1955) found that for authoritarian personalities, attitudes of racial prejudice seemed most modifiable in either an accentuated or diminished direction under an authoritarian suggestion method. A non-authoritarian information method, while effective for non-authoritarian subjects, tended to "boomerang" for

relatively authoritarian subjects.

Attributes of the communicator in relation to attitude change have been extensively studied. Investigations testing the influence of the referent group as communicator have found the referent group as extremely important in attitude change (Kelley and Woodruff, 1956; Nowak, 1960; Brophy, 1946; Newcomb, 1943, 1948; Asch, 1951, 1952; Sherif et al. 1954).

By varying the source of the communication, Hovland and Weiss (1951) found that the same communication had a greater effect when college students regarded its source as trustworthy and reliable than when they considered the source to be untrustworthy. Another study by Hovland and Mandell (1952) showed that the subject's evaluation of the communicator in terms of his impartiality significantly affected the degree of attitude change achieved by the communication.

The manner of presentation has been found to be influential in attitude change. Primacy versus recency of the communication, the emotional nature of the appeal, the mode of communication, and the content of the communication have been investigated to a considerable degree.

Since most environmental education programs can be categorized as education "about the environment," and hope education "for the (preservation of) environment" is taking place, the role of content and objective evidence in changing attitudes becomes important (Lucas, 1972). Generally,

there is no question about the desirability of distributing information based upon scientific facts as widely as possible, but research has not shown that a subsequent attitudinal change can be assumed.

As examples, Flowerman (1949) indicated that information which runs counter to established groups norms is not likely to have much effect on recipients who are members of these groups no matter how "factual" or "scientific" it might be.

In summarizing research on persuability, Janis and Hovland (1959) stated there was evidence that persuability exists as a "content free" factor; that is, it exists independent of the subject matter or appeals presented in any particular communication.

In studying the relationship between ego-defense and attitude change, Katz, McClintock and Sarnoff (1956) also concluded that information may be secondary in attitudinal change. They found that affect-laden attitudes are more effectively influenced through attempting to give insight into the self than through providing information.

In attempting to change negative attitudes, which appeal should be used--emotional or rational? Past experimental research on this question has produced contradictory results. For instance, Hartmen (1936) in attempting to persuade people to vote Socialist, and Menefee and Granneberg (1940) in regard to the isolationist-collective security issue, have

reported experimental data showing that communication with emotional appeals were relatively more effective than those using purely rational appeals. On the other hand, Knower (1935) arrived at results showing that emotional appeals may be less effective than rational ones in producing favorable attitudes toward prohibition.

In dealing with one aspect of emotional appeal--that of fear-arousal, an often-used method in environmental education (e.g. population explosion), research has shown that communications arousing guilt feelings, under certain circumstances, results in defensive reactions, and thus, doesn't have the desired effect. Indeed, Haefner (1956), upon examining the effects of both fear-arousal and guilt arousal, found a lesser degree of acceptance of the content of communication when strong feelings of fear or guilt were elicited.

This does not mean that such appeals are undesired; it depends on the type of behavior the investigator eventually wants to change. As found by Taylor (1956), the arousal of anxiety facilitates simple learning but tends to interfere with complex learning.

Although a multiplicity of variables affect attitudes, the present educational and political institutions support the idealistic philosophy that attitudes and attitude change should result from rational decisions based on objective information. Following from this premise is the assumption

that environmental problems eventually can only be solved by rational judgements of an unbiased, informed public.

Environmental Studies

Within the past few years, an increasing number of studies have been concerned with determining how informed the public is about the environment and the extent of "favorable" environmental attitudes. The pertinent studies with the above objectives shall be reviewed and categorized as follows: (1) Environmental Knowledge Studies, (2) Environmental Attitude Studies, and (3) Environmental Knowledge-Attitude Relationship Studies.

Environmental Knowledge Studies

The National Environment Test (Lynch and Chandler, 1970) was unique in that it was a nationally broadcast CBS Television documentary. In the application of the test, it was considered useful and interesting to provide the participants with a series of standards against which they could measure their own performance. Therefore, the CBS News Poll was utilized to administer the test to a national sample of 450 individuals age sixteen and older. The questions dealt primarily with pollution and conservation of natural resources.

From 27 scoring questions worth 4 points each, 56 points or less was arbitrarily rated as poor; 60-72 points

as fair; 76-80 points as good; and 92 points or higher as excellent. With these criteria, the national sample average score was 52 points; being rated in the poor category. Only 3 percent were in the excellent category; 15 percent rated good, 28 percent were fair, and 54 percent failed the test.

In general, those from the western part of the country had higher scores than those from the east. Males scored higher than females, and people in the 30-44 age group scored higher than the young people from 16-20.

In a study to determine which resources were considered important by intermediate grade students in Ohio, and the extent to which resource understandings were developed, Graff (1962) asked fourth, fifth, and sixth graders in rural, suburban, and urban schools to write a short essay on "What Conservation Means to Me." Student responses were placed in the following categories: general natural resources, minerals, soil, water, plants, animals, recreation, other natural resources (air and space), human resources, institutional aspects, and socioeconomic inference. Responses were subdivided for scope (mention of the resource area), and depth (evidence of one or more conservation understandings about the resource).

Tape-recorded interviews with 38 students from the 2,232 students sampled indicated that students' verbal responses were no better than their written ones.

Generally, less than 10 percent of the students ex-

pressed understandings about minerals, other natural resources, recreation, human resources, institutional aspects, and socioeconomic inferences. Four resources were considered most important in the order named: (1) plants, (2) animals, (3) soil, (4) water. Students associated plants and animals much more frequently than soil and water. Between 20 and 25 percent evidenced conservation understandings in one of the above resource areas; 35-45 percent considered two resources; 20 percent held understandings in three resource areas, and 10 percent indicated some understanding in all four areas.

In the urban and suburban schools, conservation understandings were developed to the greatest extent in the fifth grade, but decreased in the sixth grade. Only in the rural schools did the students evidence an increase in the number of conservation understandings in each grade.

Environmental Attitude Studies

In a series of publications by Barnett (1970, 1971, no date), several factors were related to attitudes toward population control. In one survey of 134 adult women living in a limited income family housing project in a relatively small and isolated American community, it was reported that the view of continued population growth as being a problem in the United States was endorsed more strongly than the view that the couple had a responsibility to limit its

fertility because of overpopulation; and that concern with population growth was only loosely associated with acceptance of the individual responsibility attitude (Barnett, 1970). Barnett further concluded that measures explicitly intended to control population growth probably cannot be adopted until there is a strong correlation between general population concern and individual responsibility.

Barnett (1971) in a survey of Zero Population Growth, Inc. members, found that among members under 30 years of age, the idea that the two-child family or one-child family was thought necessary for immediate population stability had no bearing on intentions for two versus less than two natural children. In addition, the majority of those cognizant of the necessity of the one-child family intended to have two natural children, even when they felt the United States was already greatly overpopulated. This supports Barnett's proposition that there is no intrinsic link between concern with population growth as a general problem and the personal commitment to limit the number of one's natural children to what is necessary for population stabilization.

Steiner (1971) developed an instrument containing several factors based on socially significant science related issues. In field testing the instrument on about 300 high school seniors in Oregon, he found significant differences on three of the factors. On one factor consisting of questions regarding optimism and belief in the utility of

science and technology, significant differences were found based on the environment of the students. Rural seniors scored highest, suburban seniors next, and urban seniors were lowest. On another factor designed to measure attitudes about the importance of individual freedom and rights, males scored significantly higher than females. There was also a significant positive correlation between the amount of science students had taken in high school and scores on a factor assessing a need for individual responsibility and sacrifice.

Barnhart (1971) used the same instrument on 414 teachers in Oregon. The results were: (1) Disillusionment with science was significantly greater among non-science teachers than science teachers, (2) Non-science teachers showed a significantly greater belief in the utility and ability of science and technology than science teachers; and (3) science teachers exhibited greater desire to have and to allow individual freedom than non-science teachers.

Environmental issues have become popular items in national polls in the last ten years. Erskine (1972), in examining the major polls, summarized their findings regarding major environmental concerns. When the first polls on pollution appeared in 1965, only about one in ten considered the problem very serious. Today most people have come to that opinion. Easterners were the most concerned about both water and air pollution. Southerners, the least. In the

Midwest, unclean water was a primary issue; in the West, air pollution ranked comparatively higher. Suburban dwellers seemed to be more aroused over the environment than big city residents.

The environment does approach top priority today for expanded governmental spending in the opinion of the citizenry. According to the Harris Survey in 1965, only three or four out of ten were personally willing to spend any money at all for correction of air or water pollution. From 1967 to 1971 they reported the numbers willing to pay 15 dollars a year more in taxes to finance a federal program to control air pollution had moved from 44 to 59 percent. In late 1971 Roper found six or seven out of ten would pay ten percent higher prices for a number of products if it were essential to pay for eliminating pollutants produced by their manufacture.

In reviewing air pollution surveys of deGroot and Samuels (1962), Smith, Schueneman, and Zeidberg (1964), Medalia and Finkner (1965), Williams and Bunyard (1966), and Crowe (1968); Swan stated the following conclusions:

> (1) Despite exposure to significantly high levels of air pollution, few people interviewed spontaneously expressed concern for air pollution.
>
> (2) When asked specifically if air pollution bothered them, more people then agreed that it did. The validity of this finding as a measure of concern for air pollution, however, is questionable because of the findings by Williams and

> Bunyard (1966) that more people say they are "bothered" by air pollution than actually recognize its existence in their neighborhood.
>
> (3) The relationship between level of air pollution in an area and expressed concern for air pollution by residents of the same area is unclear. Also inconclusive is the relationship between socio-economic class and concern.
>
> (4) Few people say they want to complain about air pollution, and even fewer actually ever complain publically (Swan, 1969a, pp. 10-11).

Johnson (1970) recently reported on a survey of environmental concerns in the Los Angeles area. It was found that all social classes and races viewed air pollution as one of the most important problems facing the Los Angeles area. The middle and upper classes ranked air pollution as the number-one problem, while Blacks and Mexican-Americans viewed racial injustice, poverty, police harassment, and the inadequacies of the schools as even more pressing. The working class and the poor worried most about crime and delinquency.

In regard to pollution, most respondents were bothered enough to support rather drastic actions. When questioned about oil spills, 94 percent favored a change in off-shore drilling by the oil companies; 43 percent advocated stopping all off-shore operations. Similarly, 83 percent favored a government ban on insecticides, such as DDT, that harm animal life. And 79 percent favored giving government

authorities the power to shut down any plant or factory that cannot or will not meet air pollution standards.

When asked who or what was mainly responsible for various forms of pollution, one-third mentioned industry or corporations, 8 percent blamed the government, 28 percent felt the public to be the source, and 21 percent placed primary responsibility upon the automobile.

The results of the survey indicated that high proportions of the public, at least in the Los Angeles area, would support practically any measure which promised relief from pollution. One half of those interviewed expressed an interest in joining a citizen's organization concerned with conservation and pollution of the environment. However, when asked if they would attend a demonstration protesting smog, only 31 percent answered in the affirmative. But 72 percent expressed a willingness to support a boycott of specific automobiles which had been designated as high polluters. There was even more support, 76 percent, for a general boycott of all new automobiles for a period of time.

Environmental Knowledge-Attitude Relationship Studies

Wievel (1947), in an Iowa study, attempted to measure attitudes toward and knowledge of conservation of high school freshmen and seniors. From results using a self-devised instrument, Wievel concluded the following:

(1) Students whose grades were above

average made higher scores on the attitude scale and general achievement test than students whose grades were average or below.

(2) Significant differences in attitude and general and specific achievement existed among the grade level groups, with seniors making higher scores on all parts of the test than freshmen.

(3) Place of residence, when classified as farm and non-farm, was associated with significant differences in general achievement and achievement in soil conservation. Farm students made higher scores on these parts of the test. Students living on farms did not differ significantly in their attitudes, or in achievement in wildlife, forest, mineral or water conservation from non-farm students.

(4) Students who had taken a greater number of courses in the natural sciences had more favorable attitudes toward conservation and made better scores on the general achievement test.

(5) Students who had taken some courses in agriculture made higher scores on all parts of the test than students who had not taken these courses.

(6) There was a tendency for students who had taken a greater number of courses in the social sciences to have slightly more favorable attitudes toward conservation and to make slightly lower scores on the general achievement test.

(7) There was a significant tendency for students who had engaged in a greater number of conservation activities to achieve better scores on both the attitude scale and the general achievement test.

(8) Males made higher scores than females on all parts of the test and these differences in scores were significant, except in the case of achievement in mineral conservation (Wievel, 1947, pp. 73-76).

Laug (1960) developed an attitude questionnaire designed primarily to determine if attitudinal change in conservation could be achieved in an experimental group exposed to "practical" conservation activities. Students from a college freshman biology class were randomly placed in control and experimental groups. The treatment involved a two-week conservation unit, using lectures, visual aids, special films and field experience. Results of the study showed significantly favorable attitudinal gains by only the experimental group.

Bowman (1972) developed an instrument to assess college students' attitudes toward the determinants of environmental issues. In field testing the instrument on 252 college students enrolled in an environmental management course and comparing results with a control, she found that student attitudes changed significantly as a result of the course. Attitudes moved toward favoring society as the determinant of environmental issues rather than the individual.

Swan (1969a) reported a study designed to develop and test new instruments for assessing attitudes and coping responses to air pollution of 173 senior boys in a Detroit high school. The relationship between concern for air pollution and visual awareness of air pollution was studied with a photographic technique. A positive correlation was obtained between awareness and concern, but it was only significant for high socio-economic status subjects. Swan

studied the relationship between concern for air pollution and technical knowledge of air pollution. As predicted, no significant relationship was found. Despite the relatively high concern expressed for air pollution, the subjects knew relatively little about air pollution or local control efforts.

Fitzsimmons (1965) used social issues and public affairs documentaries in an attempt to influence knowledge, attitudes and potential behavior. Randomly placing 300 college students into experimental and control groups, the following pertinent results were:

> (1) Generally, exposure to documentaries led to modification of attitudes in the expected direction.
>
> (2) The amount of factual information learned was not related to initial attitudes.
>
> (3) Where both attitude change and information gain occurred, there was a significant but limited relationship between the two: the greater the gain in factual information, the greater the shift in attitudes.
>
> (4) While information gains related to attitude change, there was little support for any consequent relationship of change in reported potential behavior (Fitzsimmons, 1965, p. vi).

Whiteman (1965) attempted to ascertain if it was possible to change existing attitudes toward conservation concepts by exposing students to conservation subject matter which was a part of the college freshman biology course.

The unit developed for the experimental group was general in nature and of five-weeks duration. Attitude goals were not included in the objectives of this unit as the researcher was endeavoring to determine if the teaching of the fundamentals of conservation per se had any effect upon attitude change.

Employing a conservation attitude change instrument developed by Laug (1960), a pretest-posttest design was used to determine if any change in the class mean had taken place as a result of the unit. It was found that there was a significant change in the positive direction in attitudes of the experimental groups which was not shown in the control groups. Sex was not a statistically significant factor in attitude change.

George (1966), using a Likert-type attitude scale related to conservation, compared results of high school students, college students, and adults. The conservation attitude scores were compared first for differences between groups. Secondly, the scores were related to factors affecting conservation attitudes, personal characteristics, extracurricular activities, and 4-H conservation projects. The third phase dealt with attitude change results from a "special conservation educational experience" designed especially for each of the three groups. A comparison of total mean scores showed significant differences in attitudes among all three groups. Of the four personal characteristics

studied (sex, age, education, residence), it was found that age and education were associated with the most significant differences in attitudes of the high school students.

In the analysis of the special conservation educational experience, it was found that attitudes toward conservation did change, and that this change was associated with interest motivation and exposure to conservation knowledge.

Eaton (1971), in a study to investigate tenth grade students' attitudes toward environmental quality and health knowledge, compared data from a tenth grade vocational agriculture class, a tenth grade biology class and a random sample of all tenth grade students from each of twelve randomly selected Pennsylvania schools. Evaluative criteria included the Health Education Test: Knowledge and Application, and an environmental attitude inventory utilizing the semantic differential technique. The correlation between health knowledge and environmental attitudes was not significant for the random sample of tenth graders. However, a significant positive relationship was found to exist between health knowledge and environmental attitude among vocational agriculture boys and biology students.

Brown (1971) conducted an investigation of attitudes toward selected drugs, knowledge of drugs, and the relationship between drug attitudes and drug knowledge among 428 students in grades five through twelve. Positive drug attitudes were defined as those attitudes which were favorable

or accepting toward a particular drug. Negative drug attitudes were defined as those attitudes which were not favorable toward a particular drug. On a "Drug Knowledge Test," senior high school students scored significantly higher than junior high students and junior high students scored significantly higher than elementary students. When students were grouped by grades, drug knowledge reached a plateau at the tenth grade. Among junior and senior high school students, there was a significant negative relationship between accurate drug knowledge and negative drug attitudes. In other words, as knowledge of drugs increased, favorable attitudes also increased.

The effects of the amount of information about a concept and the type of bias in information (strong positive, slight positive, slight negative, and strong negative) was investigated by Cole (1964). The amount of information about concepts and bias in information were systematically varied to study their effects on attitudes toward experimental concepts. Both variables were found to affect the intensity of attitudes. The intensity of attitudes increased as the amount of information increased and as bias intensity increased. However, bias in information had the greatest effect.

Tichenor et al. (1972) analyzed results from public opinion surveys conducted in four communities in Minnesota in 1969 and 1970. Issues involved mining in a canoeing

area (BWCA), a steel plant, and a taconite plant. It was found that as persons became more informed about a new public proposal, they became more skeptical about it. In the study, Silver Bay respondents were most highly informed about the very issue on which they most opposed restrictive measures--the taconite issue. Similarly, the Ely respondents had highest knowledge of the BWCA issue and were most opposed to preventing mining there. In knowledge on all three issues, it was clearly higher in the three communities (Ely, Silver Bay, Duluth) where one of these issues was immediately relevant and lowest in the fourth community (Grand Rapids) where these issues were more remote. Yet it was Grand Rapids where there was highest support for restrictive measures. It was concluded that there was considerable likelihood that general public support for environmental measures may fall off as people (a) learn more about the specific nature of the issues involved and (b) interpret the proposals for restriction as possibly harmful to local community interest.

Summary

Research has generally shown that relationships between behaviors and attitudes are complex and poorly understood. This is partly due to disagreement on the nature of attitudes and their measurement. On a philosophical basis, however, a change in attitudes would preceed a rational

behavioral change. But this is unsubstantiated by research and it is generally agreed that the reverse is probably the case.

Several researchers have been successful in relating attitudes and attitude change (both positive and negative) to knowledge and knowledge increase.

Environmental knowledge and attitudes have also been related to several demographic variables. In general, older students did better on enviromental achievement tests and had more positive attitudes than younger students. Males usually scored higher than females on achievement tests, but this advantage in environmental knowledge could not be related to attitude changes.

Differences in environmental knowledge and concern were also related to place of residence and in some cases to socio-economic variables.

In an educated society, knowledge should be the basis of rational decision-making and attitude change. However, the reality of knowledge-based attitudes and rational decision-based behavior dealing with the environment is being questioned. The purpose of this study is primarily to determine the extent of some environmental attitudes and if a knowledge base to those attitude does, indeed exist.

CHAPTER III

DESIGN OF THE STUDY

Introduction

This study involved the measurement of environmental knowledge and attitudes of a sample of tenth grade and twelfth grade students from a stratified random sample of schools in five Great Lakes and six Far Western states. This study is a part of a national survey designed to eventually assess environmental knowledge and attitudes of students in all 50 states and the District of Columbia.

The inventory used in the study was developed by staff of the ERIC Clearinghouse for Science, Mathematics, and Environmental Education and the Center for Science and Mathematics Education at The Ohio State University and by selected consultants.

Within each of the schools included in the study, up to 30 tenth grade students and 30 twelfth grade students were administered one of three forms of the inventory.

Gathered data were automatically transferred from machine scoreable answer sheets to computer cards for analysis

and summary by standard computer programs. Frequency counts and percentages, correlations, and chi square programs were employed to analyze the data.

This chapter is divided into the following sections: (1) The Population; (2) The Sample; (3) Instrumentation; (4) Data Collection Procedures; (5) Analysis of Data.

The Population

The population consisted of all 8999 public secondary schools in the states of Alaska, California, Hawaii, Illinois, Indiana, Michigan, Nevada, Ohio, Oregon, Washington, and Wisconsin as listed by Gertler (1970). The population for this study was subdivided into the Great Lakes region, and the Far West region. Table 1, p. 51 presents the reported number of secondary schools in each of the states of the two regions which comprised the total population.

The Sample

Overview

The number of secondary schools selected from each of the eleven states within the Great Lakes and the Far West regions was calculated on the basis of the ratio of their secondary school enrollment to the total United States secondary school enrollment. Comparable steps at the state and county levels, respectively, determined the numbers of

TABLE 1

POPULATIONS, SAMPLE SIZE, RESPONSE RATE, AND FOLLOW-UP DATA FOR SCHOOLS

State & Region	Population	Sample size	No. of initial pos. resp.	No. of initial neg. resp.	No. of pos. resp. from follow-up	No. of neg. resp. from follow-up	Total no. of resp.	Percent of sample	Total no. of pos. resp.	Percent of sample	Sch. ret. usable ans. shts.	Percent of sample
Ill	859	90	32	13	8	14	67	74.4	40	59.7	28	31.1
Ind.	613	61	23	14	4	12	53	86.9	27	44.3	21	34.4
Mich.	886	105	40	18	10	13	81	76.4	50	47.2	37	34.9
Ohio	1073	77	39	9	3	7	58	75.3	42	54.5	32	41.6
Wisc.	626	44	18	7	4	9	38	86.4	22	50.0	15	34.1
Reg.I	6528	378	152	61	29	55	297	78.6	181	47.9	133	35.2
Alas.	65	3	2	0	0	1	3	100.0	2	66.7	2	66.7
Calif.	1429	192	52	26	14	59	151	78.6	66	34.4	43	22.4
Haw.	82	8	4	3	0	0	7	87.5	4	50.0	2	25.0
Nev.	70	5	3	1	0	0	4	80.0	3	60.0	3	60.0
Ore.	337	18	9	3	1	3	16	88.9	10	55.6	6	33.3
Wash.	488	41	16	7	2	8	33	80.5	18	43.9	10	24.4
Reg.II	2471	267	86	40	18	71	214	80.1	103	38.6	66	24.7
Reg.I&II	8999	645	238	101	47	173	511	79.2	284	44.0	199	30.9

[a]Positive respondents were those saying they would participate, even though completed answer sheets may not have been returned. Also, all figures are given in numbers of schools, not the number of answer sheets.

schools that were selected for the sample from the secondary student population in every county in the eleven states within the two regions. Individual schools were then randomly selected from the alphabetical listings given in the state education directories.

Within the schools, 30 tenth grade students and 30 twelfth grade students were randomly selected by the principal from alphabetical listings of enrollments, or a representative tenth grade class and a representative twelfth grade class were selected. Figure 1, p. 53 summarizes the overall stratification of the sampling design.

Sample Selection

Selection of samples within states. It was decided that a sample of 2,000 secondary schools from the total United States population of secondary schools would be practical for administration and analysis, and sufficient to determine the status and trends in environmental knowledge and attitudes. The number of schools to be sampled in each state was the ratio of the total secondary school enrollments of that state to the total United States secondary school enrollment as reported by Kahn and Hughes (1969).

Thus:

$$n_{state} = \frac{N_{state(s)}}{N_{total(s)}} \times N$$

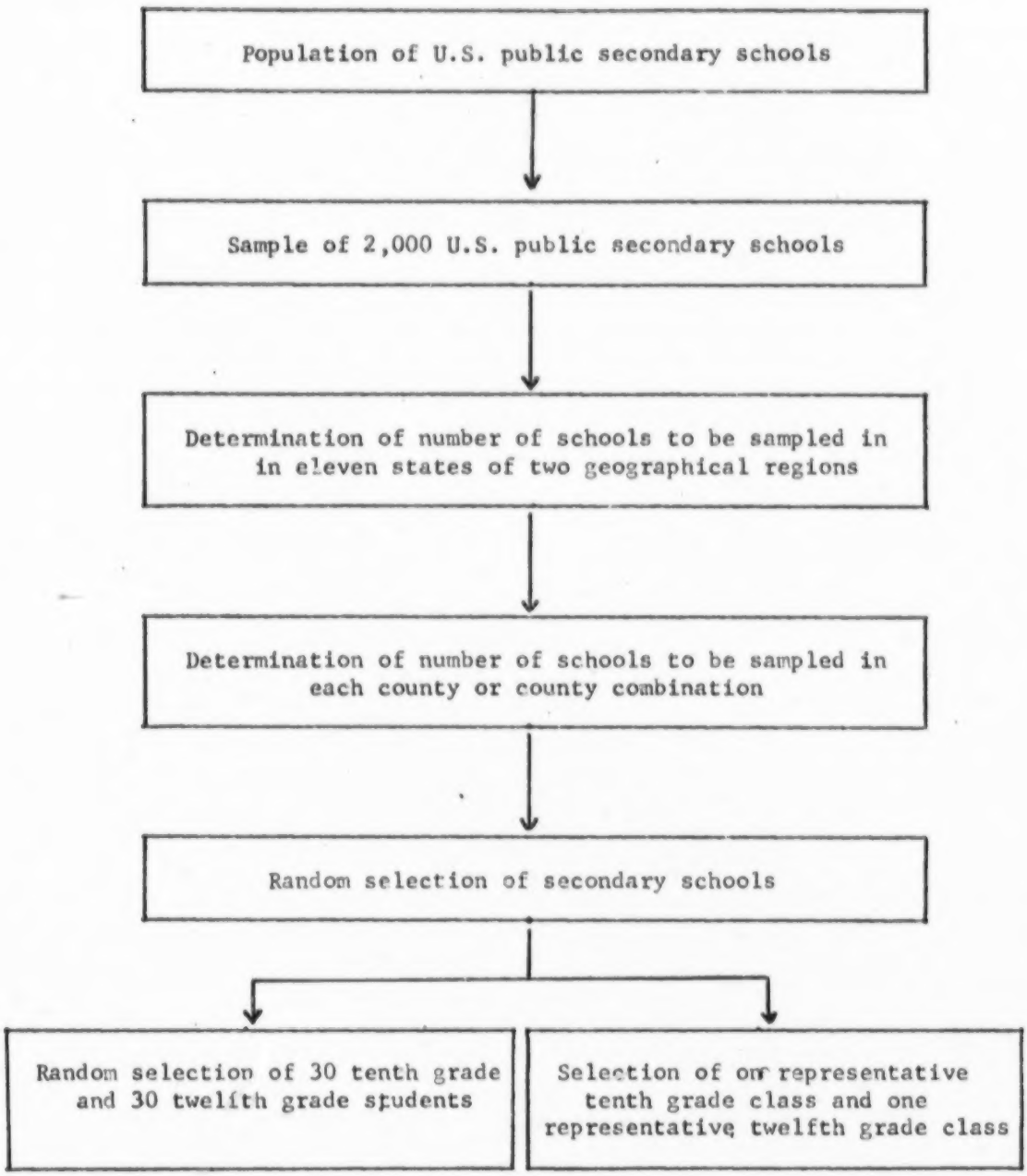
Population of U.S. public secondary schools
Sample of 2,000 U.S. public secondary schools
Determination of number of schools to be sampled in in eleven states of two geographical regions
Determination of number of schools to be sampled in each county or county combination
Random selection of secondary schools
Random selection of 30 tenth grade and 30 twelfth grade students
Selection of one representative tenth grade class and one representative twelfth grade class

Figure 1 Flow Chart of the Sampling Design

where n_{state} = number of public secondary schools to be sampled in a state

$N_{state(s)}$ = secondary school enrollment in a state

$N_{total(s)}$ = total U.S. secondary school enrollment

N = model sample size = 2,000 public secondary schools

As an example, the computation to determine the number of secondary schools to be sampled in Ohio would be:

$$n_{state} = \frac{N_{state(s)}}{N_{total(s)}} \times 2{,}000$$

$N_{Ohio(s)}$ = 680,960 secondary school students

$N_{total(s)}$ = 17,543,239 secondary school students

Hence:

$$n_{Ohio} = \frac{680{,}960}{17{,}543{,}239} \times 2{,}000$$

$$= 77 \quad \text{public secondary schools}$$

An advantage of using the ratio of state secondary enrollment and national secondary enrollment instead of the ratio of number of secondary schools in the state and the total number of United States secondary schools, is that no bias was introduced due to variations in school enrollments. In other words, a state with a large number of secondary schools with low enrollments would not be weighted over states having fewer schools, but with larger enrollments.

Using the above method, the sample size for each state

was determined. The sample size for each state is found in Table 1, p. 51 .

Selection of samples within counties. Once the number of secondary schools within a state was determined, a method was employed to calculate the number of schools to be sampled within each county.

Initially, a state unit population was determined from the ratio of the total state elementary and secondary enrollment and the state sample size.

$$\text{Unit population for a given state} = \frac{N_{state\ (E,S)}}{n_{state}}$$

where $N_{state\ (E,S)}$ = school enrollment (elementary and secondary for a state)

n_{state} = number of secondary schools to be sampled in a state.

Again, using Ohio as an example, the unit population was found as shown:

$N_{Ohio\ (E,S)}$ = 2,316,273 students

n_{Ohio} = 77 public secondary schools

Hence:

Ohio unit population = 30,081

= 30,081 students per public secondary school sample unit

In determining the state unit population, it is noted that both elementary and secondary enrollments were used. One consequence of using the combined enrollment was a

possible weighting of sample size in those counties which contained a larger than normal ratio of elementary students to secondary students. However, because data reported from some districts and counties were readily available only as total enrollment values, and due to variation in definition of what grade levels constituted secondary or elementary grades; combined elementary and secondary enrollments were used to preserve uniformity in the sampling procedures.

The unit population number for each state is the number of elementary and secondary students represented by one sampled secondary school in that state. Hence, each school sampled (approximately 60 students per school) in Ohio represented 30,081 public elementary and secondary school students.

The unit populations computed for each state included in this study were as follows:

Illinois	23,653	Alaska	21,886
Indiana	18,146	California	22,541
Michigan	19,267	Hawaii	21,094
Ohio	30,081	Nevada	20,821
Wisconsin	19,425	Oregon	24,052
		Washington	18,589

To determine the eventual number of schools to be sampled in a county, the total number enrolled in elementary and secondary schools in that county was divided by the unit population. If district figures were available, enrollments in all districts within the county were summed. In Franklin County, Ohio, the following calculations were made:

Total school enrollment in Franklin County = 177,707

Unit population for Ohio = 30,081

Number of public secondary schools sampled from the population of public secondary schools in Franklin County, Ohio = $\frac{177,707}{30,081}$

(nearest whole number) = 6

In those cases where the county enrollment was less than one-half the unit population for that state, one or more neighboring counties were combined so that total enrollment of the counties would represent at least one unit population.

As an example from the state of Ohio, Clermont County with 21,959 enrollment (.853 of one unit population) was combined with neighboring Brown County with 6,076 enrollment (.202 of one unit population). One school was then selected from the combined counties.

In summary, the number of schools to be sampled per state was determined from a ratio of the number of public secondary students in the state and the total number of secondary students in the United States. The ratio was then multiplied by 2,000, the number of schools in the national sample. The state unit population was then calculated by dividing the number of schools to be sampled from that state into the total elementary and secondary enrollment in that

state. The unit population was divided into the county or combined counties elementary and secondary enrollment to compute the number of schools to be sampled in that county or combination of counties.

Using random number tables, schools were selected from alphabetical listings of secondary schools within the county. In the case of combinations of smaller counties, the county from which the sample school would come was first randomly selected. This was followed by the selection of a school within that county.

Selection of students within schools. Students to be sampled were selected in one of two ways, depending on the preference of the school principal: (1) A random selection of 30 tenth grade students and 30 twelfth grade students from alphabetical listings of the total enrollment of students in those grades. If the school had an enrollment of less than 30 students in the tenth grade and/or less than 30 students in the twelfth grade, all students in those grades were included in the sample. (2) The principal (or some other designated person) was asked to choose two representative classes, one of predominately tenth grade students, and one of predominately twelfth grade students.

Table 2, p. 59 contains the numbers and percentages of schools electing the two alternatives.

TABLE 2

NUMBER AND PERCENTAGES OF SCHOOLS USING RANDOM AND REPRESENTATIVE SAMPLING PROCEDURES

State & Region	Total Number of Schools	Sampling Procedures: Random	%	Representative	%
Illinois	28	10	35.7	18	64.3
Indiana	21	9	42.9	12	57.1
Michigan	37	10	27.0	27	73.0
Ohio	32	14	43.8	18	56.2
Wisconsin	15	7	46.7	8	53.3
Region I	133	50	37.6	83	62.4
Alaska	2	1	50.0	1	50.0
California	43	12	27.9	31	72.1
Hawaii	2	1	50.0	1	50.0
Nevada	3	0	0.0	3	100.0
Oregon	6	4	66.7	2	33.3
Washington	10	3	30.0	7	70.0
Region II	66	21	31.8	45	68.2
Region I&II	199	71	35.7	128	64.3

Instrumentation

Inventory Development

The inventory used was initially developed by staff of the ERIC Clearinghouse for Science, Mathematics, and Environmental Education and the Center for Science and Mathematics Education at The Ohio State University and selected consultants.

A total of 404 items were submitted as possible for inclusion in the inventory. After trials with eighth, tenth, and twelfth grade students and suggestions for exclusion or inclusion by consultants, 88 questions were selected.

Since it was considered that this number of items was in excess of what could be placed on one inventory, three forms were developed, each containing 39-40 items. Some of the items were included on one form, some on two forms, and some on three forms of the inventory in order to provide a reliability measure. The number of the items found on one, two, or all three forms are listed in Appendix A , p. 143.

Copies of the three forms of the inventory are included in Appendix C , p. 156.

The subject matter of the 88 questions fell into the following four broad areas:

(1) Bio-physical Environment

(2) Scientific-Technological Influences on the Environment

(3) Environmental Health and Safety

(4) Social Influences on the Environment

Multiple choice items were written which dealt with facts, concepts, and attitudes pertinent to the above areas. The status, trends, and controls operating within the areas were considered in item development.

Pilot Data for Inventory

Piloting of items used in the three forms of the inventory was conducted in an urban school in Oregon and one in Ohio; a suburban school in Ohio; and a rural school in Washington and another in Ohio.

Stage I of the piloting tested about 400 items with eighth and tenth grade students in an urban school in Oregon and an urban and a suburban school in Ohio. At least 20 students in each school responded to each potential inventory item. Items were discussed with the students to determine if they were understandable.

After deletions of many items and rewriting of others, Stage II was conducted in the same schools as in Stage I and in an additional rural school in the state of Washington. In this case eighth, tenth, and twelfth grade students were given the items. Again the items were discussed with the students and deletions were made. Certain items were also rewritten.

Stage III involved eighth, tenth, and twelfth grade

students from the schools involved in Stage I and an additional school in rural Ohio. The inventory used in this stage contained 82 items from previous trials plus six new items.

The 88 items to which those students in Stage III responded were divided among the three inventory forms with 39-40 items per form. This allowed for the repetition of many items on more than one form. This procedure also served as reliability check.

Data Collection Procedures

Initial School Contact

Contact with the sample schools was made through the principal from December 10-20, 1972. He received a cover letter explaining the source, purpose, and implications of the study. The letter requested that his school participate in the study and if so, would consequently receive results pertinent to that school and state (See Appendix B , p. 149). Accompanying the cover letter was an ERIC publication, E R I C: How To Use It For Environmental Education (1971). Also, a return form and self addressed stamped envelope were provided whereby the principal indicated his desire to- or not to- participate. If the principal was interested, but lacked authority to act on his interest, space was provided for the name and address of the person from whom permission could be obtained.

Positive Respondents

Those willing to participate and having the authority to grant permission to do so received instructions for administration to representative classes or to randomly selected students, along with 60 inventories and answer sheets. (See Appendix B, p. 149.)

Positive Respondents Needing External Permission

Where additional permission was needed, the person with authority to grant permission was contacted. The letter requested permission to conduct the study in the school or schools under his jurisdiction and stated the source, purpose, and implications of the study. If permission was granted, the school was again contacted.

Follow-up of Positive Respondents

Of the 238 schools who initially indicated they would participate in the study, 86 did not send in completed answer sheets by March 15, 1973. These were contacted by follow-up letter (See Appendix B , p.149) and when requested, additional testing materials were forwarded to the schools. By the cut-off date of May 15, 1973, useable answer sheets had been received from 27 of these 86 schools.

Follow-up of Negative Respondents

Those not responding to the initial contact were sent a follow-up letter (See Appendix B , p. 149). Of the 306

schools not responding to the initial contact, 47 responded favorably to the follow-up and were sent testing materials. By the cut-off date of May 15, 1973, useable answer sheets had been received from 20 of these 47 schools.

Figure 2, p. 65 shows a flow chart of data collection procedures.

Materials Received after Cut-off Date

As of June 30, 1973 an additional 44 schools returned useable answer sheets. A preliminary analysis showed no significant differences from those included in the study.

A final analysis which will include all materials received prior to November 1, 1973, will be conducted by the Center for Science and Mathematics Education at The Ohio State University.

Administration of Inventories

Testing materials sent to the schools were divided into two packets; one for tenth grade students and one for twelfth grade students. In each packet there were 30 inventories (10 of each form) and 30 answer sheets. Also, instructions for administration were included. Students were instructed to write the school code on the answer sheet and mark in the appropriate boxes the inventory form, sex, grade, size of the community where the school was located and size of the community where the student lived.

A sample of the instructions for inventory

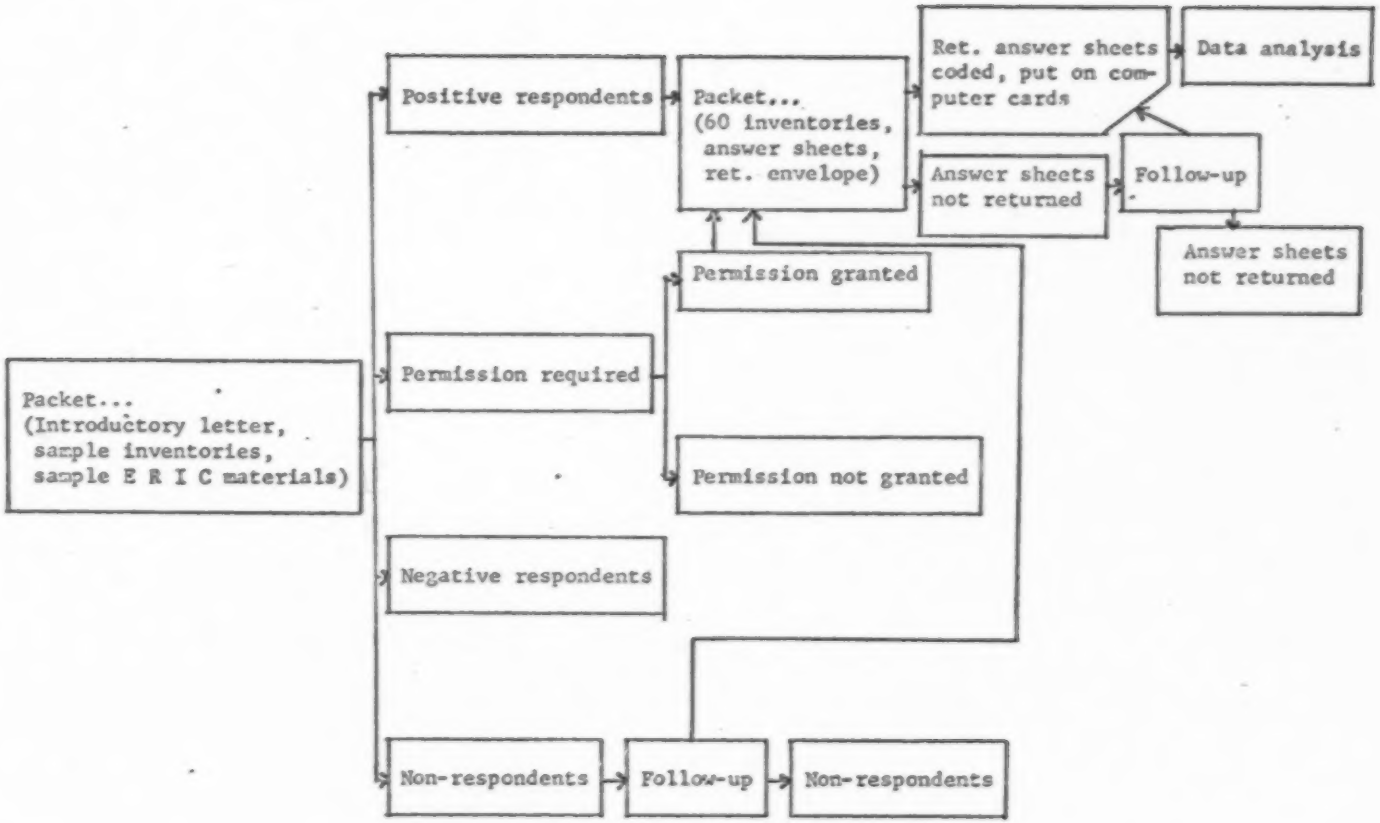

Figure 2 Flow Chart of Data Collection Procedures.

administration are found in Appendix C , p. 156.

Analysis of Data

Variables related to the answers of those questions found in Chapter I, page 11 , were analyzed by use of the BEACH frequency count and percentage program developed at The Ohio State University. Percentages and responses to the various items were compared by region and state.

For discussion purposes, the 88 items found on the environmental knowledge and attitude inventories were grouped under the following headings: Ecology, Population, Natural Resources, Energy Sources and Use, Land Use, General Pollution, Air Pollution, Water Pollution, Noise Pollution, Solid Wastes, Radiation, Environmental Health and Safety, Social Influences on the Environment, and Societal Problems.

Using the computer program, BMD02D, developed by the Health Science Computer Facility, UCLA (1970), the following independent variables were correlated with student responses to the 70 environmental knowledge items on the inventories: sex; grade level (tenth or twelfth); size of the community where the school is located (1-1,000; 1,000-10,000; 10,000-50,000; 50,000-100,000; over 100,000); and size of the community where the school is located (1-1,000; 1,000-10,000; 10,000-50,000; 50,000-100,000; over 100,000). Individual item responses were also correlated with a total knowledge score.

With samples greater than 1,000, a small correlation ($r = 0.062$) is found to be different from zero at the .05 level of significance. Such a correlation accounts for less than .36 percent of the total variance.

So that relationships might be considered which contribute more than a minute amount to the variance, an arbitrary limit was set which at least represented one percent of the variance ($r = 0.10$).

Of the 88 items found on the inventories, 18 were attitude items and were analyzed by means of a chi square computer program developed by Nie, Bent, and Hull (1970). Differences in attitudes were discussed based on sex; grade level (tenth and twelfth); state of residence (Illinois, Indiana, Michigan, Ohio, Wisconsin, Alaska, California, Hawaii, Nevada, Oregon, Washington); size of community where the school is located (1-1,000; 1,000-10,000; 10,000-50,000; 50,000-100,000; over 100,000); and size of community where the student lives (1-1,000; 1,000-10,000; 10,000-50,000; 50,000-100,000; over 100,000).

Due to large differences in sample sizes between states and the large number of cases in some states, significant chi square values could be found when differences in responses between states were minimal. Therefore, a chi square statistic using proportions was calculated.

Results of these descriptive, correlational, and chi square analyses of the data are found in Chapter IV.

CHAPTER IV

RESULTS AND DISCUSSION

Overview

The results of the environmental knowledge and attitudes survey conducted in the eleven states within the Great Lakes and Far West regions are presented in this chapter. Included data relate to the hypotheses posed in Chapter I, page 11 .

Discussion of results is organized into the following subheadings: Response Rate, Random Versus Representative Sampling, Descriptive Analysis of Knowledge and Attitude Variables, Correlational Analysis of Knowledge Variables, and Chi Square Analysis of Attitude Variables.

Response Rate

The population was comprised of the 4,057 secondary schools in the five states in the Great Lakes region, and the 2,471 secondary schools in the Far West region. Of the total population of 8,999 schools, 378 and 267 schools were selected for the stratified sample from the Great Lakes and

the Far West regions, respectively. The 645 schools represented about ten percent of the total student population. In the Great Lakes region, 133 schools (35.2 percent) and in the Far West region, 66 schools (24.7 percent) administered the inventories and returned the answer sheets prior to May 15, 1973. Table 1, page 51 summarizes the numbers and percentages of usable returns from each of the regions and included states.

As of June 30, 1973, an additional 44 schools returned usable answer sheets. A preliminary analysis showed no significant differences from those included in the study.

A final analysis will be conducted by the Center for Science and Mathematics Education, The Ohio State University, on all materials received prior to November 1, 1973.

Random Versus Representative Sampling

Since there were two means by which students were chosen to participate in the study, it became necessary to determine if this variable related to item responses. When student responses on all knowledge items and the total knowledge score were correlated with mode of sampling, in no case were the correlations significantly different from zero.

Therefore, it was concluded that it made no measurable difference whether a student was randomly selected from an alphabetical listing of students, or was selected as a

member of a representative class within the school. Hence, results from schools using random selection of students were pooled with results from schools administering the inventories to entire representative classes.

Descriptive Analysis of Knowledge and Attitude Variables

Comparisons were made on the basis of frequency counts and percentages acquired by means of the BEACH computer program developed at The Ohio State University. Results of these analyses are found in Tables 3-25, p. 71-89.

A list of knowledge and attitude variables, names, and position on the inventory is found in Appendix A, p. 143.

For discussion purposes, variables were grouped on the basis of subject matter. The following categories are discussed in this section: Ecology, Population, Natural Resources, Energy Sources and Use, Land Use, General Pollution, Air Pollution, Water Pollution, Noise Pollution, Solid Wastes, Radiation, Environmental Health and Safety, Social Influences on the Environment, and Societal Problems. In the following discussion the terms "agree" and "disagree" are frequently used. These terms were possible answers for items dealing with general knowledge, and therefore, cannot be assumed to be responses to attitude items.

Ecology

This group of items was comprised of general ecological

TABLE 3

KNOWLEDGE AND ATTITUDE VARIABLES LISTED BY SUBJECT MATTER CATEGORY[a]

Category	Know. Var. Number	Position on Inventory	Attit. Var. Number	Position on Inventory
Ecology	17	A-19		
	19	A-21,B-21,C-21		
	20	A-22		
	24	A-26		
	25	A-27		
	64	C-22		
	68	C-26		
Population	3	A-3	5	A-30,B-30,C-30
	28	B-3	15	B-28,C-28
	51	C-2		
	54	C-5		
Natural Resources	8	A-8		
	11	A-11		
	21	A-23		
	38	B-13		
	41	B-16,C-20		
	42	B-19,C-19		
	44	B-22		
	45	B-23		
	46	B-24		
	48	B-26		
	49	B-27		
	66	C-24		
	67	C-25		
	69	C-27		
Energy Sources and Use	2	A-2		
	29	B-4		
	40.	B-15		
	50	C-1		
Land Use	1	A-1	1	A-16,B-17,C-17
	27	B-2	16	B-40
General Pollution	39	B-14	4	A-29,B-29,C-29
	47	B-25	13	A-38,B-38,C-38
			14	A-39,B-39,C-39

TABLE 3, cont.

Category	Know. Var. Number	Position on Inventory	Attit. Var. Number	Position on Inventory
Air Pollution	14	A-14		
	15	A-15		
	30	B-5		
	35	B-10		
	53	C-4		
	61	C-13		
	63	C-16		
Water Pollution	6	A-6		
	9	A-9		
	10	A-10		
	32	B-7		
	42	B-19,C-19		
	43	B-20		
	56	C-8		
	57	C-9		
	58	C-10		
	59	C-11		
Noise Pollution	18	A-20		
	34	B-9		
	60	C-12		
Solid Wastes	31	B-6		
	36	B-11		
	52	C-3		
	55	C-6		
	70	C-15		
Radiation	4	A-4		
	5	A-5		
	26	B-1		
Env. Health-Safety	7	A-7	2	A-17,B-18,C-18
	12	A-12	17	C-7
	13	A-13		
	16	A-18		
	33	B-8		
	37	B-12		
	62	C-14		
Social Influences	22	A-24	3	A-28
	23	A-25	9	A-34,B-34,C-34
	65	C-23	10	A-35,B-35,C-35
			11	A-36,B-36,C-36
			12	A-37,B-37,C-37

TABLE 3, cont.

Category	Know. Var. Number	Position on Inventory	Attit. Var. Number	Position on Inventory
Societal Problems			6	A-31,B-31,C-31
			7	A-32,B-32,C-32
			8	A-33,B-33,C-33
			18	C-40

[a]See Appendix C, page 157, for Inventory A.
[a]See Appendix C, page 163, for Inventory B.
[a]See Appendix C, page 170, for Inventory C.

TABLE 4

PERCENTAGE FROM EACH STATE RESPONDING CORRECTLY TO KNOWLEDGE VARIABLES

Var. No.	Ill.	Ind.	Mich.	Ohio	Wisc.	Alas.	Cal.	Haw.	Nev.	Ore.	Wash.
1	69.2	71.2	69.8	67.1	66.0	57.9	71.3	64.1	67.7	57.2	62.1
2	57.0	62.8	53.7	61.0	60.9	79.0	53.2	43.6	38.7	45.4	60.3
3	30.4	38.7	34.5	32.1	27.7	15.8	30.8	23.1	35.5	40.3	41.0
4	35.9	41.2	40.7	42.3	42.2	42.1	38.0	41.0	45.2	48.7	50.9
5	32.6	30.3	30.7	31.9	36.3	36.8	32.1	33.3	21.0	42.0	32.3
6	28.4	24.0	26.4	23.8	28.5	31.6	26.2	7.7	27.4	26.1	21.7
7	57.0	54.1	59.7	56.7	59.4	73.7	60.0	51.3	48.4	52.9	62.7
8	28.4	25.5	30.2	29.6	30.9	21.1	29.5	25.6	32.3	35.3	31.7
9	47.5	50.5	48.1	51.0	51.2	42.1	45.2	46.2	59.7	44.5	50.9
10	33.7	35.4	36.7	42.3	38.3	42.1	33.6	25.6	29.0	39.5	38.5
11	40.6	40.2	42.7	42.1	46.1	36.8	43.2	38.5	35.5	32.8	41.0
12	55.9	55.6	51.2	59.2	70.3	21.1	48.4	35.9	43.6	52.9	55.3
13	72.5	70.0	69.7	66.5	71.9	68.4	59.0	64.1	64.5	67.2	63.4
14	40.1	41.7	39.3	37.9	41.8	36.8	28.8	35.9	29.0	35.3	32.9
15	54.3	55.6	50.1	56.3	45.7	57.9	62.4	74.4	53.2	63.0	62.1
16	46.1	42.6	46.9	45.6	50.8	31.6	39.7	48.8	46.8	44.5	36.7
17	94.5	93.7	91.6	93.3	93.8	100.0	92.9	89.7	87.1	89.9	91.9
18	75.6	72.4	74.2	75.2	74.6	68.4	76.4	74.4	69.4	70.6	77.0
19	74.2	71.7	75.6	72.3	75.8	71.0	70.9	70.6	65.7	71.1	73.4
20	64.5	58.0	64.5	60.6	64.1	57.9	63.5	46.2	62.9	59.7	70.8
21	72.5	70.3	69.4	70.8	69.5	73.7	67.4	74.4	64.5	72.3	74.5
22	71.6	73.9	75.2	76.5	77.0	68.4	73.0	66.7	66.1	74.8	68.9
23	67.6	68.2	71.3	68.5	61.7	47.4	68.7	64.1	56.4	70.6	64.6
24	73.2	74.8	74.9	75.6	74.2	63.2	75.1	74.4	69.4	75.6	78.9

TABLE 4, cont.

Var. No.	Ill.	Ind.	Mich.	Ohio	Wisc.	Alas.	Cal.	Haw.	Nev.	Ore.	Wash.
25	69.2	68.5	70.6	69.4	68.0	73.7	66.3	64.1	79.0	63.0	69.6
26	47.7	53.3	51.7	50.6	52.4	73.2	47.2	61.0	51.7	42.7	54.4
27	29.9	31.1	28.2	26.6	27.3	52.6	34.1	46.3	36.2	42.7	31.9
28	34.8	37.7	38.8	39.6	37.3	36.8	36.8	31.7	31.0	45.3	41.3
29	38.2	36.1	29.7	34.0	34.1	36.8	32.3	41.5	29.3	27.4	34.4
30	86.6	86.1	85.2	86.4	83.7	94.7	82.4	75.6	87.9	83.8	86.9
31	21.4	25.5	30.0	28.5	28.2	10.5	28.3	26.8	31.0	22.2	25.0
32	14.8	7.9	11.4	11.7	14.7	15.8	11.3	24.4	6.9	7.7	8.1
33	85.9	82.5	82.3	84.5	84.1	94.7	85.9	78.1	82.8	94.0	91.3
34	74 0	71.2	77.7	71.3	80.2	73.7	73.7	73.2	74.1	76.1	85.6
35	55.7	52.3	51.8	55.5	55.6	80.0	50.1	41.5	53.5	56.4	56.3
36	39.7	39.1	43.4	39.2	42.1	47.4	38.1	24.4	31.0	53.9	46.9
37	36.5	34.4	37.1	30.0	36.5	31.6	34.0	19.5	32.8	30.8	23.8
38	46.0	44.0	45.4	44.0	42.9	63.2	42.6	56.1	46.6	45.3	45.6
39	54.3	47.0	50.2	52.3	50.4	42.1	44.2	39.0	44.8	53.8	47.5
40	38.4	41.4	42.6	44.3	35.7	57.9	41.2	41.5	46.6	38.5	33.8
41	24.7	25.5	28.8	25.8	30.5	22.7	24.2	26.2	19.0	21.0	29.8
42	53.6	48.8	56.2	58.7	55.8	65.2	51.7	43.7	51.8	56.9	56.0
43	5.4	5.6	6.9	5.1	4.8	0.0	5.0	7.3	12.1	0.9	3.1
44	78.4	77.8	78.1	77.2	77.8	79.0	75.2	75.6	69.0	79.5	80.6
45	75.7	75.8	76.1	72.8	76.6	79.0	71.4	80.5	77.6	71.8	75.0
46	48.2	47.0	53.8	48.7	51.2	68.4	50.5	46.3	36.2	53.9	56.3
47	52.8	53.0	54.0	51.3	64.3	63.6	46.8	56.1	53.5	45.3	42.5
48	41.1	38.4	47.4	43.8	43.7	47.4	41.1	46.3	36.2	41.9	41.3
49	65.9	63.6	69.1	61.3	68.3	68.4	58.4	58.5	55.2	66.7	63.8
50	65.4	65.1	67.9	65.9	71.7	81.0	67.8	64.1	50.0	54.7	69.6
51	44.0	37.7	42.5	43.3	39.6	47.6	39.2	46.2	39.7	41.0	43.9
52	77.9	63.8	75.9	75.3	76.7	76.2	72.9	69.2	67.2	78.6	80.4
53	24.4	21.7	27.1	21.4	25.8	28.6	17.7	15.4	24.1	17.1	21.6

TABLE 4, cont.

Var. No.	Ill.	Ind.	Mich.	Ohio	Wisc.	Alas.	Cal.	Haw.	Nev.	Ore.	Wash.
54	17.3	13.2	14.9	21.2	17.9	38.1	38.1	33.3	36.2	29.1	31.1
55	45.0	49.1	44.3	46.8	47.9	47.6	45.1	43.6	37.9	47.9	51.4
56	40.5	36.8	46.3	37.9	57.1	23.8	42.9	43.6	24.1	39.3	37.8
57	48.9	49.1	48.1	60.0	45.4	38.1	46.2	41.0	39.7	45.3	40.5
58	49.6	37.4	45.2	38.1	44.6	52.4	39.4	59.0	31.0	33.3	27.7
59	30.5	19.5	30.6	25.8	25.8	28.6	24.0	38.5	24.1	29.1	29.1
60	30.8	33.0	27.6	29.5	32.9	38.1	29.6	33.3	27.6	33.3	33.1
61	29.8	34.6	29.9	32.4	35.8	28.6	35.2	38.5	27.6	34.2	30.4
62	83.2	79.6	82.2	78.6	83.8	81.0	79.0	66.7	77.6	82.1	75.7
63	42.8	42.5	44.3	44.0	45.4	52.4	55.1	46.2	46.6	45.3	42.6
64	77.1	74.5	79.8	76.4	81.3	100.0	78.5	82.1	75.9	86.3	79.7
65	65.9	66.4	65.5	63.9	65.0	66.7	62.8	64.1	64.8	64.1	64.9
66	56.7	53.1	57.2	52.7	55.4	66.7	50.9	46.2	62.1	45.3	62.2
67	64.4	66.4	64.1	65.4	67.5	66.7	63.4	61.5	60.3	53.9	70.3
68	67.7	64.2	68.4	65.7	67.5	76.2	64.8	71.8	65.5	65.8	66.9
69	43.5	39.9	45.0	46.0	41.3	43.4	28.6	43.6	48.3	39.3	41.2
70	72.5	73.6	74.1	73.5	71.7	81.0	66.6	74.4	79.3	74.4	70.1
Mean	51.7	50.3	52.2	51.6	52.9	54.1	50.1	49.8	48.6	51.0	52.1
$N_{Form\ A}$ =	451	333	693	480	256	19	715	39	62	119	161
$N_{Form\ B}$ =	411	302	606	479	252	19	665	41	58	117	160
$N_{Form\ C}$ =	393	318	605	457	240	21	599	39	58	117	148

TABLE 5

STATE SUMMARY OF RESPONSES TO ENVIRONMENTAL KNOWLEDGE VARIABLES

Var. No.	N	Alternatives 1	2	3	4	Other	Percent giving correct resp.
1[a]	3618	715	1778*	701*	387	37	68.9
2	3618	2013*	331	405	808	61	55.6
3	3618	1212*	1117	1221	-	68	33.5
4[a]	3618	576	1519	661*	822*	40	41.0
5	3618	276	1214	919	1158*	51	32.0
6	3618	811	606	925*	1192	84	25.6
7	3618	182	182	1020	2120*	114	58.6
8	3618	615	1352	1077*	530	44	29.8
9	3618	1165	1762*	473	205	13	48.7
10	3618	243	1334*	869	1103	69	36.9
11	3618	664	745	1522*	633	54	42.1
12	3618	301	1971*	223	1077	46	54.5
13	3618	2404*	548	442	201	23	66.4
14	3618	1700	1305*	538	-	75	36.1
15	3618	236	585	687	2014*	96	55.7
16	3618	1616*	684	214	1030	74	44.7
17	3618	144	3364*	-	-	110	93.0
18[a]	3618	392	1133*	1596*	440	57	75.4
19	10264	7647*	1058	887	597	76	74.5
20	3618	2299*	536	553	211	19	63.5
21	3618	2534*	455	300	295	34	70.3
22	3618	2671*	449	317	156	25	73.8
23	3618	2458*	537	371	223	29	67.9
24	3618	2727*	335	284	241	31	75.4
25	3618	2485*	534	335	236	28	68.7
26	3388	264	612	1729*	763	20	51.0
27	3388	482	1453	1060*	366	27	31.3
28	3388	315	443	1276*	1288	66	37.7
29	3388	231	1678	1133*	317	29	33.4
30[a]	3388	2074*	796*	214	265	39	84.7
31	3388	1864	925*	393	193	13	27.3
32	3388	950	1951	388*	82	17	11.5
33	3388	189	2874*	202	111	12	84.8
34	3388	237	122	355	2549*	125	75.2
35	3388	522	1813*	915	-	138	53.6
36	3388	592	1377	1364*	-	55	40.3
37	3388	1950	1151*	132	147	8	34.0
38	3388	1062	1522*	566	211	27	44.9
39	3388	1644*	1688	-	-	56	48.6
40	3388	385	1389*	1552	-	62	41.0
41	6647	370	1405	3064	1701*	102	25.6
42[a]	6647	432	1646*	1945*	2525	109	67.2
43	3388	1479	1161	189*	531	28	5.6

TABLE 5 ,cont.

Var. No	N	Alternatives 1	2	3	4	Other	Percent giving correct resp.
44	3388	2616*	356	202	200	14	77.2
45	3388	2504*	355	400	114	15	73.9
46	3388	1721*	714	411	488	54	50.8
47	3388	1754*	300	1187	126	21	51.8
48	3388	1443*	627	682	596	40	42.6
49	3388	2176*	402	484	296	30	64.2
50[a]	3259	387	862*	1301*	675	34	66.4
51	3259	272	814	1359*	775	39	41.7
52	3259	137	426	183	2430*	83	74.6
53	3259	431	723	1893*	200	12	58.1
54	3259	1170	548*	1330	185	26	16.8
55	3259	104	159	1413	1502*	81	46.1
56	3259	509	1370*	452	875	53	42.0
57	3259	675	643	279	1601*	61	49.1
58	3259	1359*	880	565	425	30	41.7
59	3259	259	1096	1013	863*	28	26.5
60	3259	416	987*	1069	748	39	30.3
61	3259	903	1069*	589	644	54	32.8
62	3259	2640*	117	390	97	15	81.0
63	3259	1498*	1558	137	47	19	46.0
64	3259	2563*	321	275	88	12	78.6
65	3259	2105*	518	362	250	24	64.6
66	3259	1790*	649	411	379	30	54.9
67	3259	2108*	464	439	216	32	64.7
68	3259	2162*	421	318	320	38	66.3
69	3259	1406*	464	1037	316	36	43.1
70[a]	3259	807*	442	378	1552*	80	72.4
Mean							52.4

*Correct response

[a]Has two correct responses

TABLE 6

NUMBERS OF HIGH[a] AND LOW[b] PERCENTAGES FOR KNOWLEDGE VARIABLES CATEGORIZED BY SUBJECT MATTER

State	Ecology	Population	Nat. Res.	Energy	Land	Gen'l. Poll'n	Air Poll'n	Water Poll'n	Noise Poll'n	Solid Wastes	Radia-tion	Health-Safety	Social Infl.	Total
Ill.	3H	1H	1H	1H	0H	1H	0H	0H	0H	0H	0H	3H	0H	10H
	0L	0L	0L	0L	0L	0L	0L	0L	0L	1L	1L	0L	0L	2L
Ind.	0H	0H	0H	1H	1H	0H	1H	1H	0H	1H	0H	0H	0H	5H
	2L	2L	5L	0L	0L	0L	1L	2L	1L	1L	1L	0L	0L	15L
Mich.	1H	0H	2H	0H	0H	0H	0H	3H	0H	2H	0H	2H	2H	12H
	0L	1L	0L	0L	0L	0L	1L	0L	1L	0L	0L	1L	0L	4L
Ohio	1H	0H	2H	1H	0H	0H	0H	4H	0H	0H	0H	1H	0H	9H
	0L	0L	2L	0L	1L	0L	0L	0L	1L	0L	0L	0L	0L	4L
Wisc.	0H	0H	3H	1H	0H	1H	3H	2H	1H	0H	0H	4H	1H	16H
	0L	0L	0L	0L	1L	0L	1L	0L	0L	0L	0L	0L	0L	2L
Alas.	4H	2H	7H	2H	1H	1H	4H	6H	1H	2H	2H	2H	0H	34H
	2L	1L	1L	0L	1L	1L	1L	3L	1L	1L	0L	2L	1L	15L
Cal.	0H	1H	1H	0H	1H	0H	1H	0H	1H	0H	0H	0H	0H	5H
	0L	1L	4L	0L	0L	0L	2L	2L	0L	1L	2L	1L	0L	13L
Haw.	1H	0H	2H	1H	1H	0H	2H	3H	1H	0H	1H	0H	0H	12H
	4L	2L	2L	1L	0L	1L	3L	3L	0L	2L	0L	5L	1L	24L
Nev.	1H	0H	2H	1H	0H	0H	1H	1H	0H	2H	0H	0H	0H	8H
	5L	1L	7L	3L	0L	0L	2L	6L	2L	3L	1L	1L	2L	33L
Ore.	2H	2H	2H	0H	0H	1H	2H	0H	1H	1H	2H	1H	1H	15H
	1L	0L	6L	2L	1L	1L	2L	2L	0L	1L	1L	0L	0L	17L
Wash.	2H	2H	6H	0H	0H	0H	0H	0H	2H	2H	1H	1H	0H	16H
	0L	0L	1L	0L	1L	1L	2L	0L	0L	0L	0L	4L	0L	9L

[a] One of the two states having the largest percentage of students responding correctly to an item.
[b] One of the two states having the smallest percentage of students responding correctly to an item.

TABLE 7

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 1

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	82.0	11.4	2.3	4.2	0.1
Indiana	953	75.7	13.5	3.5	6.4	0.8
Michigan	1904	78.5	10.0	2.4	8.2	1.0
Ohio	1407	78.4	13.2	3.0	5.0	0.4
Wisconsin	748	79.3	13.6	1.8	4.7	0.6
Alaska	59	67.9	11.6	6.7	13.9	0.0
California	1979	72.6	17.0	3.2	6.7	0.5
Hawaii	119	76.6	10.8	4.3	8.4	0.0
Nevada	178	71.9	19.1	1.6	7.3	0.0
Oregon	353	66.6	22.1	4.8	6.2	0.3
Washington	469	77.0	16.5	3.2	3.4	0.0

TABLE 8

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 2

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	32.7	11.8	16.9	36.3	2.3
Indiana	953	34.3	11.5	20.5	30.6	2.9
Michigan	1904	31.5	14.7	14.5	36.4	2.8
Ohio	1407	39.3	11.4	15.9	31.7	1.8
Wisconsin	748	32.2	13.5	15.8	36.9	1.6
Alaska	59	27.4	18.0	16.9	37.8	0.0
California	1979	29.5	12.0	15.6	39.7	3.2
Hawaii	119	33.6	10.1	15.1	38.7	2.5
Nevada	178	36.5	6.8	19.7	34.9	2.2
Oregon	353	33.4	19.8	16.1	29.2	1.4
Washington	469	26.7	14.2	17.5	39.9	1.7

TABLE 9

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 3

State	N	Alternatives 1	2	3	4	Other
Illinois	451	80.3	9.8	5.1	4.0	0.9
Indiana	333	81.4	6.9	8.1	3.0	0.6
Michigan	693	81.7	8.1	4.8	4.3	1.2
Ohio	480	85.6	4.4	4.0	5.4	0.6
Wisconsin	256	80.1	10.9	4.7	4.3	0.0
Alaska	19	89.5	10.5	0.0	0.0	0.0
California	715	79.3	8.0	5.0	5.3	2.4
Hawaii	39	74.4	12.8	5.1	2.6	5.1
Nevada	62	74.2	8.1	11.3	4.8	1.6
Oregon	119	77.3	10.9	5.0	6.7	0.0
Washington	161	78.3	6.8	8.1	6.2	0.6

TABLE 10

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 4

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	42.6	13.1	37.3	6.2	0.9
Indiana	953	42.3	19.2	30.6	6.6	1.2
Michigan	1904	35.2	18.0	38.3	8.6	0.0
Ohio	1407	41.7	15.8	34.0	7.3	1.3
Wisconsin	748	35.2	18.0	38.3	8.6	0.0
Alaska	59	52.6	15.8	26.3	5.3	0.0
California	1979	43.2	13.4	35.5	6.4	1.4
Hawaii	119	30.8	15.4	35.9	15.4	2.6
Nevada	178	40.3	14.5	35.5	6.5	3.2
Oregon	353	36.1	11.8	43.7	7.6	0.8
Washington	469	54.0	14.9	23.6	6.8	0.6

TABLE 11

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 5

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	37.5	18.4	40.6	-	3.6
Indiana	953	33.9	19.8	42.9	-	3.3
Michigan	1904	36.4	14.6	46.2	-	2.9
Ohio	1407	39.4	14.8	44.0	-	2.9
Wisconsin	748	39.1	18.8	41.4	-	0.8
Alaska	59	21.1	31.6	36.8	-	11.5
California	1979	39.1	18.7	38.6	-	3.6
Hawaii	119	33.3	28.2	35.9	-	2.6
Nevada	178	35.5	9.7	50.0	-	4.8
Oregon	353	42.9	14.3	38.7	-	2.5
Washington	469	34.8	20.5	41.6	-	3.1

TABLE 12

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 6

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	11.2	24.8	35.9	27.2	1.0
Indiana	953	20.8	25.6	33.2	19.3	1.1
Michigan	1904	14.5	29.4	27.9	27.3	1.0
Ohio	1407	17.2	26.6	28.3	26.9	0.9
Wisconsin	748	9.5	42.8	27.5	19.8	0.4
Alaska	59	37.3	22.0	27.2	11.8	1.8
California	1979	44.3	7.1	17.0	30.2	1.3
Hawaii	119	5.0	20.9	21.0	51.3	1.7
Nevada	178	35.3	14.1	24.2	24.7	1.7
Oregon	353	15.6	17.8	35.4	29.7	1.4
Washington	469	14.2	25.8	25.8	33.6	0.6

TABLE 13

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 7

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	25.6	28.9	19.2	25.2	1.0
Indiana	953	24.8	21.2	30.2	22.4	1.3
Michigan	1904	26.3	24.1	27.0	21.1	1.5
Ohio	1407	26.2	26.6	21.6	24.4	1.4
Wisconsin	748	37.1	22.4	15.9	23.7	0.9
Alaska	59	39.0	20.4	28.8	16.2	1.6
California	1979	30.9	26.0	27.0	14.5	1.7
Hawaii	119	11.7	47.1	29.5	10.0	1.7
Nevada	178	26.8	25.8	32.1	13.6	1.6
Oregon	353	25.5	32.8	14.6	24.4	1.4
Washington	469	29.6	29.5	23.2	17.0	0.6

TABLE 14

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 8

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	50.8	13.8	15.0	18.9	1.4
Indiana	953	44.5	22.4	13.1	18.3	1.6
Michigan	1904	49.8	20.5	12.2	16.3	1.3
Ohio	1407	47.7	17.9	14.6	18.8	1.1
Wisconsin	748	56.4	11.8	11.5	19.3	1.0
Alaska	59	42.0	22.0	32.6	1.8	1.6
California	1979	54.8	18.2	14.0	11.4	1.6
Hawaii	119	67.3	17.7	5.9	5.8	3.4
Nevada	178	53.2	22.6	8.4	5.7	2.2
Oregon	353	51.8	15.0	13.9	18.4	0.9
Washington	469	53.1	15.6	17.3	12.5	1.5

TABLE 15

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 9

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	7.1	14.6	69.0	7.5	1.8
Indiana	953	6.9	13.8	70.9	6.3	2.1
Michigan	1904	6.9	16.9	67.0	7.8	1.4
Ohio	1407	9.0	17.3	64.8	7.9	1.0
Wisconsin	748	8.2	19.5	63.7	8.2	0.4
Alaska	59	15.8	26.3	47.4	10.5	0.0
California	1979	6.4	15.8	65.9	9.8	2.1
Hawaii	119	18.0	15.4	48.7	12.8	5.1
Nevada	178	11.3	12.9	66.1	8.1	1.6
Oregon	353	5.9	21.0	62.2	10.9	0.0
Washington	469	7.5	20.5	64.0	7.5	0.6

TABLE 16

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 10

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	51.9	19.1	24.0	4.0	1.1
Indiana	953	48.4	15.6	25.5	9.0	1.5
Michigan	1904	48.3	16.7	25.3	8.7	1.0
Ohio	1407	52.5	18.1	20.4	7.7	1.2
Wisconsin	748	44.5	18.8	27.3	8.2	1.2
Alaska	59	57.9	10.5	21.1	5.3	5.3
California	1979	47.1	19.7	22.4	8.5	2.2
Hawaii	119	43.6	10.3	28.2	12.8	5.1
Nevada	178	62.9	11.3	19.4	4.8	1.6
Oregon	353	50.4	17.7	24.4	5.9	1.7
Washington	469	49.1	21.1	17.4	11.8	0.6

TABLE 17

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 11

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	34.6	25.5	29.3	8.8	1.8
Indiana	953	35.7	18.0	31.8	12.6	1.8
Michigan	1904	34.8	22.9	32.0	8.9	1.3
Ohio	1407	36.9	22.5	29.0	10.4	1.3
Wisconsin	748	34.8	21.9	30.1	12.5	0.8
Alaska	59	31.6	47.4	21.1	0.0	0.0
California	1979	32.7	24.9	26.0	13.3	3.1
Hawaii	119	25.6	10.3	35.9	23.1	5.1
Nevada	178	40.3	17.7	32.3	8.1	1.6
Oregon	353	37.8	29.4	21.9	9.2	1.7
Washington	469	32.3	26.1	26.1	14.9	0.6

TABLE 18

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 12

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	17.7	24.4	44.1	11.5	2.2
Indiana	953	19.5	18.0	48.7	11.7	2.1
Michigan	1904	17.6	22.2	47.8	11.1	1.3
Ohio	1407	17.3	20.6	48.8	12.3	1.0
Wisconsin	748	18.0	20.7	48.4	11.7	1.2
Alaska	59	26.3	21.1	42.1	10.5	0.0
California	1979	18.5	21.3	45.6	12.3	2.4
Hawaii	119	15.4	12.8	46.2	23.1	2.6
Nevada	178	16.1	17.7	53.2	11.3	1.6
Oregon	353	20.2	18.5	43.7	16.8	0.8
Washington	469	12.4	17.4	52.8	16.8	0.6

TABLE 19

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 13

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	52.6	20.0	15.7	10.2	1.6
Indiana	953	54.4	18.0	13.8	11.4	2.4
Michigan	1904	53.1	22.7	12.9	9.9	1.3
Ohio	1407	53.3	20.6	15.4	9.8	0.8
Wisconsin	748	50.4	22.7	14.8	10.9	1.2
Alaska	59	57.9	31.6	5.3	5.3	0.0
California	1979	53.6	20.6	13.7	9.5	2.7
Hawaii	119	59.0	20.5	2.6	15.4	2.6
Nevada	178	37.1	25.8	17.7	17.7	1.6
Oregon	353	58.0	17.7	13.5	9.2	1.7
Washington	469	52.2	24.8	13.7	8.1	1.2

TABLE 20

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 14

State	N	Alternatives 1	2	3	4	Other
Illinois	1255	57.4	17.5	15.1	8.4	1.6
Indiana	953	58.6	17.1	12.9	9.0	2.4
Michigan	1904	60.2	20.1	9.7	7.9	2.2
Ohio	1407	58.3	22.1	10.4	7.9	1.3
Wisconsin	748	59.0	20.7	11.7	7.4	1.2
Alaska	59	68.4	21.1	10.5	0.0	0.0
California	1979	54.7	20.6	11.3	9.8	3.6
Hawaii	119	43.6	30.8	10.3	10.3	5.1
Nevada	178	50.0	21.0	17.7	9.7	1.6
Oregon	353	63.9	15.1	11.8	6.7	2.5
Washington	469	59.6	21.1	9.9	7.5	1.8

TABLE 21

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 15

State	N	Alternatives 1	2	3	4	Other
Illinois	804	68.1	12.7	13.9	4.4	1.0
Indiana	620	68.2	14.2	12.6	4.6	0.3
Michigan	1211	70.5	11.7	12.1	5.1	0.7
Ohio	927	68.1	13.6	11.9	5.3	1.1
Wisconsin	492	67.5	13.1	14.3	4.0	1.2
Alaska	40	52.6	10.5	26.3	10.5	0.0
California	1264	69.6	12.3	12.5	4.8	0.8
Hawaii	80	70.7	14.6	7.3	7.3	0.0
Nevada	116	63.8	12.1	18.9	1.7	3.4
Oregon	234	74.4	8.6	13.7	2.6	0.9
Hawaii	308	68.8	11.3	15.6	4.4	0.0

TABLE 22

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 16

State	N	Alternatives 1	2	3	4	Other
Illinois	411	55.0	18.3	13.4	11.2	1.0
Indiana	302	56.0	15.9	10.6	13.9	3.6
Michigan	606	61.6	18.8	7.8	9.2	2.6
Ohio	470	59.3	17.7	9.6	11.1	2.3
Wisconsin	252	55.6	20.6	9.5	12.3	2.0
Alaska	19	47.4	21.1	10.5	10.5	10.5
California	665	54.9	20.5	10.1	11.6	3.0
Hawaii	41	73.2	9.8	4.9	9.8	2.4
Nevada	58	58.6	22.4	6.9	5.2	6.9
Oregon	117	60.7	14.5	9.4	12.8	2.6
Washington	160	51.3	26.9	10.0	10.6	1.3

TABLE 23

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 17

State	N	Alternatives 1	2	3	4	Other
Illinois	393	22.1	58.8	17.6	-	1.7
Indiana	318	24.2	62.3	12.6	-	0.9
Michigan	605	17.0	63.8	17.2	-	2.0
Ohio	457	17.9	68.3	12.3	-	1.5
Wisconsin	240	17.5	66.3	15.0	-	1.3
Alaska	21	14.3	76.2	9.5	-	0.0
California	599	14.4	59.1	24.2	-	2.3
Hawaii	39	12.8	64.1	23.1	-	0.0
Nevada	58	19.0	63.8	13.8	-	3.4
Oregon	117	16.2	63.3	19.7	-	0.9
Washington	148	16.9	70.3	12.2	-	0.7

TABLE 24

PERCENTAGES FROM EACH STATE RESPONDING TO ATTITUDE VARIABLE 18

State	N	Alternatives 1	2	3	4	Other
Illinois	393	30.5	24.2	34.6	9.4	1.3
Indiana	318	30.8	19.5	32.7	14.2	2.8
Michigan	605	27.4	22.8	31.9	14.7	2.2
Ohio	457	26.7	23.6	34.4	13.1	2.2
Wisconsin	240	24.2	26.3	35.4	12.9	1.3
Alaska	21	28.6	19.1	42.9	9.5	0.0
California	599	28.4	26.9	28.9	12.7	3.2
Hawaii	39	38.5	41.0	15.4	5.1	0.0
Nevada	58	27.6	12.1	37.9	17.2	5.2
Oregon	117	29.9	20.5	34.2	14.5	0.9
Washington	148	30.4	19.6	36.5	10.1	3.4

TABLE 25

STATE SUMMARY OF RESPONSES TO ENVIRONMENTAL ATTITUDE VARIABLES

Var. No	N.	Alternatives 1	%	2	%	3	%	4	%	Other	%
1	10264	7889	76.9	1394	13.6	313	3.0	616	6.0	53	.5
2	10264	3327	32.4	1318	12.8	1678	16.3	3692	36.0	250	2.4
3	3618	2922	80.8	295	8.2	194	5.4	168	4.6	39	1.1
4	10264	4230	41.2	1479	14.4	3814	37.2	649	6.3	93	0.9
5	10264	3780	36.8	1825	17.8	4378	42.7	-		284	2.7
6	10264	2239	21.8	2388	23.3	2880	28.1	2794	27.2	105	1.0
7	10264	2857	27.8	2665	26.0	2557	24.9	2043	19.9	143	1.4
8	10264	5237	51.0	1864	18.2	1394	13.6	1623	15.8	147	1.4
9	10264	795	7.7	1631	15.9	6936	67.7	785	7.6	118	1.1
10	10264	4935	48.1	1744	17.0	2621	25.6	856	8.3	109	1.1
11	10264	3456	33.7	2367	23.1	3164	30.8	1147	11.2	131	1.3
12	10264	1850	18.0	2411	23.5	4606	44.9	1247	12.1	150	1.5
13	10264	5567	54.2	2188	21.3	1353	13.2	1011	9.8	146	1.4
14	10264	6065	59.1	2047	19.9	1166	11.3	825	8.0	162	1.6
15	6647	4618	69.5	770	11.6	879	13.2	329	4.9	51	0.8
16	3388	1937	57.2	637	18.8	343	10.1	377	11.1	94	2.8
17	3259	609	18.7	2035	62.4	565	17.3	-		50	1.5
18	3259	927	28.4	769	23.6	1073	32.9	409	12.5	81	2.5

principles of which most respondents were aware. At least 60 percent of the students correctly responded to each of the items.

When asked if man is a product of his heredity and environment, over 66 percent in each state agreed. When given the statement, "living things are interdependent with one another and their environment," over 70 percent agreed. Over 64 percent also agreed that natural resources are interdependent and the use or misuse of one will affect others.

The large majority (79 percent) agreed with the statement that man has the ability to manipulate and to change the environment. Nearly all states ranged between 75-80 percent of respondents agreeing with the statement. Alaskan respondents were the exception with 100 percent agreement with the statement.

About 60 percent of the respondents agreed that man has affected environmental processes in a negative way. Respondents from ten of the eleven states agreed at a rate of over 75 percent that in any environment, one component like water, air, or food might limit the type of life which could survive.

When asked to respond to the statement that organisms and environments are in constant change, about 69 percent agreed. In a question designed to see if respondents overestimated the present development of technology and science in controlling ecological forces, they were asked if man can

prevent most natural environmental problems such as hurricanes, volcanic eruption, and earthquakes. Over 92 percent knew that this presently could not be done.

Population

In regard to attitudinal questions, about 69 percent of the respondents thought that family planning and the limiting of family size is important if over population is to be avoided and a reasonable standard of living assured for future generations. However, given a choice of discouraging large families, less than 18 percent thought that the income exemption for children should be decreased rather than left at its present level or increased.

Three questions dealt with knowledge of specific facts about population. Given the choices of 2.5, 3.0, 3.5, and 4.0 billion people in the world, responses were about evenly divided between 3.5 and 4.0 billion people. The population growth rate of the United States when compared with other countries was not known by a majority of respondents. The choices were about evenly divided between a lower rate than the average for the rest of the world (33.5 percent), about the same rate as the average of the rest of the world (30.8 percent), and at a higher rate than the average of the rest of the world (33.7 percent). When asked in which type of country population growth rate is the highest, the most popular answer was "in underdeveloped countries." However,

a substantial percentage (36 percent) thought population growth rate was highest in highly industrialized countries.

Natural Resources

Knowledge of general natural resource concepts was high. Over 64 percent agreed that natural resources are interdependent and the use or misuse of one would affect others. More than 77 percent agreed that management of natural resources to meet the need of successive generations demands long range planning. About 51 percent agreed that economic efficiency does not always result in conservation of a natural resource.

A majority from all states (55 percent) also agreed that continued political and economic strength of a country is, in part, dependent upon the natural resources to which it has access. When asked if natural resources are unequally distributed with respect to land areas and political boundaries, 42 percent agreed.

About 64 percent agreed that water is a reusable resource but the available quantity can be reduced or the quality impaired. About 70 percent also agreed that increased population mobility is changing the nature of demands upon some resources. Approximately 74 percent agreed that hunting regulations are useful in maintaining game populations.

Several questions dealt with knowledge of natural

resource facts. About 43 percent of the respondents knew that minerals are nonrenewable resources; but when asked the number of years before known reserves of zinc, lead, tin, petroleum, and copper will be depleted at today's rate of consumption and given the choices of 10, 20, 40, and 80 years; respondents were about equally divided between the alternatives of 20 and 40 years.

When asked to identify nonrenewable resources and given the choices of wood and paper, iron and copper, water and air, and animals; water and air (30 percent) and animals (35 percent) were selected more often than iron and copper (25 percent). However, answers were inconsistent from state to state.

Following the statement that the United States has about 6 percent of the world's population, respondents were asked what percent of nonrenewable raw materials are consumed by the United States. The most popular answer, selected by about 45 percent of the respondents, was "25 percent."

About 42 percent of the respondents thought that ground water is being removed about twice as fast as it is being replaced. About the same percentage (45 percent) indicated that each person in the United States uses about 50 gallons of water per day for home use.

Energy Sources and Use

When asked from which source can energy be obtained on a large scale as a result of research and technical breakthroughs, about 60 percent of Great Lakes respondents and 50 percent of Far West respondents chose solar energy over tidal generation and geothermal sources.

About 50 percent of the respondents believed that our coal supply is estimated to be adequate for about 30 years, and not 3, 300, or 3,000 years. About 40 percent selected approximately the same amount of time before the known supply of natural gas runs out.

An item dealing with the amount of electrical energy used in the home, and given the choices of 10 percent, 25 percent, and 50 percent of the total power produced, respondents were about equally divided between the latter two alternatives.

Land Use

Again, most respondents were acquainted with general concepts. The majority of respondents (57 percent) agreed that comprehensive planning that considers both controlled growth and development is the only way to improve land use. Respondents from Hawaii agreed most often (73 percent).

Over 75 percent agreed that "ugliest" construction and worst pollution is located in the cities. Responses from Great Lakes states were more consistent than those from the

Far West.

Specific facts about land use were more challenging for the respondents. When given several alternatives, respondents from the Great Lakes states selected at about a 49 percent rate that land use is shifting from rural to suburban. In the Far West states, the rate was about 10 percent lower. When asked the number of people currently living in urban areas of the United States, and given the choices of 27, 47, 67, and 87 percent; 67 percent was chosen by respondents more than any other alternative.

In regard to the amount of land owned by the Federal government, about 43 percent of the respondents from the Great Lakes region selected 35 percent as closer than 10, 60, or 85 percent. However, Far West respondents had a tendency to choose 60 percent more often than Great Lakes respondents.

General Pollution

Most respondents had favorable attitudes toward pollution control. Over 50 percent thought that industries should not be allowed to contribute to pollution--either through production or with the end product. Also, 60 percent felt that controls should be placed on industry which would protect the environment even if it meant things would cost more.

When asked to respond to the statement that only strong

governmental controls would reduce pollution problems, responses were variable between states and within states on different forms of the inventory. However, if a trend was indicated, it slightly favored agreement with the statement.

Two conceptual questions were considered under this heading. The majority (52 percent) agreed that pollutants are produced by both natural and manmade processes. However, respondents were about evenly divided on a true-false question that most pollutants eventually decompose and diffuse throughout the environment.

Air Pollution

Most questions dealing with air pollution required specific knowledge. When asked how an inversion could be harmful, and given the choices of "increasing carbon dioxide content of the air," "causing pollution to stay near the ground," and "reducing horizontal air movement," about 54 percent selected the second alternative. A question dealing with the thickness of the layer of air surrounding the earth had no consistent choice. Alternatives ranging from 5 miles to 80 miles were all about randomly chosen.

In regard to how particle pollution would affect the earth's temperature, about 47 percent thought the temperature would increase, and 36 percent thought the temperature would be decreased. The third alternative, "stabilize the earth's temperature," was selected by less than 15 percent

of the respondents. When asked how burning has affected the amount of carbon dioxide in the atmosphere, about 61 percent thought that the carbon dioxide content has increased several times.

In questions about the characteristics of air pollutants, over 55 percent thought carbon monoxide to be the major air pollutant by weight, and 58 percent thought it also to be the most harmful. The major source of air pollution was thought either to be transportation or industrial processes, with solid waste disposal and homes selected very seldom. Great Lakes respondents favored slightly industrial processes as the answer, while California respondents selected transportation most frequently.

Water Pollution

Sixty-four percent of the respondents agreed that water is a reusable resource but the available quantity may be reduced or the quality impaired.

Less than 10 percent of the respondents thought that 100 percent of water pollution could be removed by industry. However, the other alternatives of 85, 65, and 50 percent were selected at about the same frequency.

In regard to the material which is removed when wastes decompose in water, only 42 percent knew that oxygen was the answer.

The cause of pollution of the ocean by oil was thought

to be caused by either offshore drilling or oil tanker operations. Only 6 percent selected motor vehicle wastes.

On a question about the persistence of DDT as a toxic pesticide, respondents were about evenly divided among alternatives ranging from "permanently toxic" to "relatively nonpersistent."

Forty-five percent of respondents believed that industry is responsible for most of water pollution. The most popular answer when asked the percentage of water pollution which was caused by industry was 65 percent. The next most frequent answer was that 95 percent of water pollution is caused by industry. When asked to be more specific, respondents seemed unsure as to which industry is responsible for thermal pollution. However, with the exception of Nevada, the electric power industry was selected more often than other alternatives.

A majority (58 percent) thought that phosphates in water bodies result from industrial sources rather than agriculture operations (2 percent). About 49 percent knew that pollution from mine drainage was most prevalent in the Appalachian area of the United States.

When asked about the percentage of the nation's population which is served by adequate sewers and treatment plants, 92 percent of the respondents were about evenly divided among the answers of 40, 50 and 70 percent. The remaining 8 percent thought nine-tenths of the homes were served

adequately by sewers and treatment plants.

Noise Pollution

Over 75 percent of respondents knew that sonic booms are caused by fast flying aircraft. However, respondents were less sure about the number of people exposed to potentially hazardous noise. Given choices of 3 million, 15 million, 40 million, and 75 million people, 63 percent of the respondents chose either 15 million or 40 million as the correct answer. Also about 31 percent thought that physiological hearing damage begins at an exposure to noise of 85 decibels. Respondents from 10 of the 11 states chose 120 decibels more often than other alternatives.

Solid Wastes

One question asked for the identification of materials which are not biodegradable. Of the choices, leaves, bread, wood, and glass; over 74 percent chose glass to be the correct answer.

Over 55 percent of respondents believed that industrial operations produce more solid wastes than residential, commercial, and agriculture operations. When asked to respond to the amount of solid wastes produced per person per week, and given the choices of 1.5 pounds, 2 pounds, 5 pounds, and 10 pounds, about 90 percent of the respondents were equally divided between 5 and 10 pounds per week.

When asked to identify the most economical process

for disposal of solid wastes and given the choices of incineration, recycling, and sanitary landfill, respondents consistently chose recycling or sanitary landfill, and less than 20 percent chose incineration. When essentially the same question was asked on another form of the inventory with alternative answers of sanitary landfill, incineration, composting, and open dump with burning; the latter answer was most frequently chosen.

Radiation

Three questions dealt with radiation: how radioactive wastes are disposed of by nuclear power plants, the greatest source of radiation to which people are exposed, and the greatest source of "manmade" radiation. In every state the most frequent answer to the first question was that nuclear power plants discharge radioactive wastes in water sources.

In regard to the greatest source of radiation to which Americans are exposed, a definite answer was not indicated. Over 90 percent knew that occupational hazards play a minor role but couldn't decide upon TV sets and luminous wrist watches, medical sources, or radiation from natural sources.

A similar question asked for the largest single source of "manmade" radiation to which Americans are exposed. The alternative answers were somewhat different; occupational hazards, again chosen by very few; nuclear power plant radiation; medical use; and TV sets and luminous wrist watches.

In this case, TV sets and luminous wrist watches was chosen as the major source of radiation by about 51 percent of the respondents.

Environmental Health and Safety

In regard to accidental injury and death in the 18-24 age group, about 54 percent of the respondents knew that auto accidents cause more injuries and deaths than suicide, disease, and drugs. However, drugs was the second most common answer and was chosen more often than the correct answer by respondents from Hawaii.

When asked in which age group accidents are the leading cause of death, about 45 percent of the respondents selected the 1-30 age group, as compared to the 30-60 age group, over 60 age group, or "all of these." Alaska respondents selected the correct answer only about 32 percent of the time and "all of these" almost half of the time.

About 58 percent of the respondents identified "on the highways" when asked where accidental deaths and injuries occur most frequently. "In the home" was selected by about 34 percent of the respondents. "Accidental injury," "death at work," and "in public places" were seldom selected.

It was known by about 81 percent of the respondents that drinking is the major factor in about 50 percent of fatal auto accidents.

There were two questions on the inventory dealing with

diseases. About 59 percent knew that the incidence of lung cancer is greater among those living in cities of over one million population than among those in less populated areas. Respondents seemed to be highly aware (85 percent) that venereal disease is a more common disease among the 17-25 age group than cancer, tuberculosis, and heart disease.

Two attitude items dealt with environmental health. When asked if fluorides should be added to drinking water, and given the choices of being mandatory, not being allowed, and optional--determined by local vote; about 62 percent thought the decision should be determined by a local vote.

About 66 percent of the respondents indicated that they thought the non-medicinal use of drugs is increasing. When given alternative measures to decrease drug abuse, respondents chose "none of the above" as often as the other most popular answer, "passing and enforcing stricter laws." Also of significance was that less than 15 percent thought that legalization of drugs would decrease drug abuse.

Social Influences on the Environment

Several conceptual and attitude items were related to social influences on the environment. A large majority (80 percent) agreed that man has responsibility to develop an appreciation of and respect for the rights of others. This response is consistent with responses from the statement, "It is more important to preserve the freedom of the

individual's choice than to enforce laws to protect the quality of life in the future," to which only 20 percent agreed. When asked if an individual has too much power in determining the way he lives, over 65 percent disagreed.

When asked if farmers are generally more concerned about environmental problems than people who live in the suburbs, over 45 percent agreed. But when asked if suburban dwellers are more concerned about environmental problems that city dwellers, answers were variable with a substantial number (23 percent) remaining neutral on the issue.

About 74 percent agreed that outdoor recreation is an increasingly important part of our culture and economy. When given the statement that increased leisure time and improved transportation have created heavy pressures on existing recreation facilities and demands for new ones, over 64 percent of the respondents agreed.

Most respondents (68 percent) agreed that choices between human needs (essentials) and human wants or desires (nonessentials) must be considered if we are to improve our quality of life.

Societal Problems

Several questions asked respondents which of a series of environmental problems is most serious in their community. When given the choices of air pollution, water pollution, solid waste disposal, and land use; California respondents

chose air pollution more often than other states. Hawaiian respondents were least concerned with air pollution and most concerned with land use. Water pollution seemed to be the greatest concern among Wisconsin respondents.

Respondents were also asked to choose among the following problems as being most serious in their community: pollution problems, land use, crime, and traffic accidents. Again, Hawaiian respondents selected land use. Traffic accidents were considered to be less important than other problems.

When the alternatives were again combined and increased to include some different choices, over 50 percent of all respondents selected pollution problems to be of more concern than land use, crime, health problems, and traffic accidents.

When asked if housing is the single most important environmental element and the area of greatest need, more respondents disagreed than agreed with the statement.

State Comparisons by Subject Matter

Chi square calculations were made to compare total score means and individual item scores across states (see Table 4, p. 74). Significant differences were found only on two knowledge items (Variable 2, Variable 12), and no significant differences at the .05 level were found in total score means. The range of total score means was from 48.6

in Nevada to 54.1 in Alaska. Excluding the small states of Hawaii, Alaska, and Nevada, means ranged from 50.1 percent in California to 52.9 percent in Wisconsin.

When knowledge items were grouped by category, differences between states were observable, but the significance of these differences must be analyzed with caution. As shown in Table 6 , p. 79, the ratio of the number of highs (one of the two states having the highest percentage of students correctly answering an item) to the number of lows (one of the two states having the lowest percentage of students correctly answering an item) varied greatly from state to state. States with small sample sizes varied more than the states with a greater number of students in the sample.

Chi square calculations (.05 level) indicated that distributions of highs and lows were not random. The highest ratio of highs to lows were for the states of Wisconsin and Illinois, while the lowest ratio was in Indiana. Alaska had the greatest number of highs, and Hawaii and Nevada had the greatest number of lows. However, the sample in these three states was small compared to other state samples.

In the Ecology section, Illinois, Alaska, and Washington had the largest ratio of highs to lows and Hawaii and Nevada the lowest. Oregon and Washington had the largest ratio on Population questions, while Indiana and Hawaii were lowest. In the Natural Resource category, Wisconsin, Alaska, and Washington had high ratios; and Indiana, California,

Nevada, and Washington were low. Alaska had the greatest number of highs on the Energy questions and Nevada and Oregon were the lowest. Highs and lows were quite evenly distributed on the Land Use section.

For the pollution sections, Alaska and Wisconsin had high ratios for Air Pollution questions; and Michigan, Ohio, and Wisconsin had high ratios for Water Pollution questions. Low ratios were found for Washington in the Air Pollution section, and for California, Nevada, and Oregon for Water Pollution questions. Noise Pollution ratios were highest in Washington and lowest in Nevada.

In response to Solid Waste items, Michigan and Wisconsin had high ratios, and Hawaii was lowest. Radiation items had a high ratio in Alaska and a low ratio in California.

In the Environmental Health and Safety category, Illinois and Wisconsin were high; Washington and Hawaii were low. In the Social Influences section, Michigan had the greatest number of highs and Nevada had the greatest number of lows.

Summary

As would be expected, respondents did quite well on those items which required only the recognition of general environmental principles. In most cases, at least 60 percent properly identified such concepts. On those items

requiring specific knowledge, scores were about 20 percent lower.

It was also noted that for general environmental attitudes, respondents tended to be quite positive. But when items required a transfer of that general positive attitude to a more specific personal situation, responses became inconsistent.

It seemed also that respondents were willing to give up a certain amount of individual freedom for support of policies and laws designed to control or remove environmental contaminates and threats to future generations.

In comparing total score means, results were quite consistent from state to state, with the largest variations coming from those states where few schools were sampled. However, the numbers of times that states had one of the two highest percentages of correct responses in a subject area, or one of the two lowest percentages of correct responses in a subject area, was found to be significantly different from state to state.

Correlation of Knowledge Variables

Overview

This section reports findings resulting from the correlation of 70 knowledge items with the independent variables of size of community where the school is located, size of community where the student lives, sex, and grade

level. The independent variables were coded as follows:

1 = School located in community with population 1-1,000
2 = School located in community with population 1,000-10,000
3 = School located in community with population 10,000-50,000
4 = School located in community with population 50,000-100,000
5 = School located in community with population over 100,000

1 = Student lives in community with population 1-1,000
2 = Student lives in community with population 1,000-10,000
3 = Student lives in community with population 10,000-50,000
4 = Student lives in community with population 50,000-100,000
5 = Student lives in community with population over 100,000

1 = Male
2 = Female

1 = Tenth grade
2 = Twelfth grade

Independent variables and knowledge items were also correlated with each other and with a total knowledge score. The total knowledge score was calculated as the percent of the knowledge items which were answered correctly.

A list of knowledge items, names, and position on the inventory is found in Appendix A, p.143.

With the number of cases being 1,000, a correlation of 0.062 at the .05 level and a correlation of 0.081 at the .01 level were found to be statistically significant. Since the number of cases in the correlational relationships in this study was never below 3,000 and sometimes over 10,000, a significant relationship could be statistically shown even

when the relationship accounted for much less than .36 percent (r = 0.06) of the variance. Even though such a correlation is significantly different from zero, its usefulness is questionable.

So that relationships might be considered which contribute more than a minute amount to the variance, an arbitrary limit was set which represented at least one percent of the variance (r = 0.10). This represents a very low probability (less than 0.001) that a null hypothesis will be falsely rejected.

Independent Variables Correlated with Knowledge Variables

The size of the community where the school was located, the size of the community where the respondent went to school, sex, and grade level were correlated with results of 70 separate knowledge items and a total knowledge score. Results of these correlations are found in Table 26, p. 110.

The relationship of the independent variables and the knowledge items will be discussed in the succeeding section. Only those relationships which were found to account for at least one percent of the total variance will be mentioned.

Size of Community. A correlation of 0.85 was found between size of community where the respondent lived and size of community where he went to school. Therefore, the size of community where the respondent lived and went to school was considered as one variable in this discussion.

TABLE 26
CORRELATIONS OF ENVIRONMENTAL KNOWLEDGE VARIABLES WITH SEX, GRADE, AND SIZE OF COMMUNITY WHERE STUDENTS LIVE AND GO TO SCHOOL

Variable Number	Sex	Grade	Location of School	Location of Home
1	-0.038	0.020	0.022	0.024
2	0.003	0.039	0.003	-0.013
3	-0.102*	0.168*	0.058	0.046
4	-0.120*	0.090	-0.014	-0.014
5	-0.060	-0.002	-0.010	-0.014
6	-0.099	0.060	-0.039	-0.040
7	-0.104*	0.031	0.020	0.004
8	-0.023	0.032	-0.015	-0.014
9	-0.001	0.013	-0.007	-0.019
10	-0.082	0.035	-0.013	-0.020
11	0.007	0.036	0.004	0.018
12	-0.087	0.093	-0.086	-0.064
13	-0.029	0.037	-0.053	-0.048
14	-0.077	0.010	-0.027	-0.029
15	-0.037	-0.005	0.009	0.010
16	-0.056	0.059	-0.012	-0.009
17	0.033	0.026	0.019	0.019
18	0.034	0.026	0.027	0.023
19	0.022	0.105*	-0.007	-0.008
20	-0.080	0.080	0.036	0.028
21	-0.038	0.029	-0.024	-0.018
22	-0.004	0.066	-0.038	-0.023

TABLE 26, cont.

Variable Number	Sex	Grade	Location of School	Location of Home
23	0.039	0.057	0.030	0.023
24	-0.018	0.088	0.000	-0.003
25	-0.010	0.050	0.020	0.018
26	-0.101*	0.019	0.019	0.002
27	0.092	-0.011	0.045	0.045
28	-0.016	-0.026	-0.035	-0.036
29	-0.011	-0.024	0.023	0.022
30	-0.035	0.011	-0.004	-0.001
31	-0.130*	0.049	0.028	0.027
32	-0.010	0.044	-0.015	-0.020
33	0.085	0.141*	-0.014	-0.015
34	-0.231*	0.072	0.011	0.016
35	-0.059	0.011	0.037	0.027
36	-0.175*	0.016	-0.056	-0.032
37	0.096	0.047	0.013	0.009
38	0.029	0.003	0.017	0.017
39	-0.060	-0.043	-0.053	-0.064
40	0.072	-0.010	0.008	-0.004
41	0.003	0.061	0.045	0.038
42	0.026	0.065	-0.029	-0.017
43	0.001	0.004	0.038	0.024
44	-0.072	0.106*	-0.001	-0.012
45	-0.076	0.072	-0.044	-0.035
46	-0.077	0.094	0.008	0.008

TABLE 26, cont.

Variable Number	Sex	Grade	Location of School	Location of Home
47	0.017	0.014	-0.006	-0.007
48	-0.079	0.101*	0.038	0.031
49	-0.034	0.073	0.005	0.003
50	-0.054	0.016	-0.007	-0.014
51	0.025	0.007	-0.032	-0.015
52	-0.087	0.093	-0.030	-0.014
53	-0.041	0.011	-0.012	-0.015
54	-0.048	0.002	-0.014	-0.016
55	-0.109*	0.049	-0.005	-0.008
56	-0.141*	0.055	0.013	-0.000
57	-0.108*	0.093	0.018	0.007
58	-0.134*	0.049	0.038	0.017
59	-0.005	0.012	-0.008	-0.025
60	0.060	-0.045	-0.021	-0.014
61	-0.013	-0.009	-0.004	-0.018
62	-0.012	0.025	0.010	0.008
63	-0.171*	0.055	0.040	0.049
64	-0.042	0.078	-0.034	-0.022
65	-0.079	0.102*	0.007	-0.011
66	-0.043	0.102*	0.027	0.007
67	0.020	0.044	0.015	0.023
68	0.006	0.060	-0.007	-0.015
69	-0.067	0.054	-0.022	-0.033

TABLE 26, cont.

Variable Number	Sex	Grade	Location of School	Location of Home
70	-0.038	0.015	-0.027	-0.022
Total Know. Score	-0.133*	0.151*	-0.007	-0.009

*Significant at greater than the 0.01 level and accounting for at least one percent of the total variance.

In no case did the size of the community significantly correlate with the knowledge items. Correlation of size of community and the total knowledge score was less than 0.009. It can be concluded that size of community was independent of environmental knowledge.

Sex. Sex was related to several of the knowledge variables and to the total knowledge score. In every instance where a significant relationship was found, males provided more correct answers than females. However, the differences shown between males and females were on those items requiring knowledge of specific facts. Responses of males to general concept items were not significantly different from those of female students.

When sex was correlated with the total knowledge score, a negative correlation of -0.133 was obtained. Since males were coded as "1" and females as "2," this indicated a significant negative relationship between females and total knowledge score.

Males scored significantly higher than females on a population growth rate item, a health item dealing with the incidence of lung cancer, three items about solid wastes, two items about radioactive sources and disposal, three water pollution items, an air pollution item, and a noise pollution item.

Several of the knowledge items were also significantly related to sex when a chi square statistic using proportions

was calculated to check for large differences in choices of alternatives by males and females.

Grade Level. Grade level was significantly correlated with a number of knowledge items and with the total knowledge score. In every instance where a significant relationship was found, twelfth graders scored higher than tenth graders. Twelfth graders and tenth graders differed on general environmental concept items. Only on two questions requiring knowledge of specific facts (a population item and a health item) did twelfth graders score significantly higher than tenth graders.

When grade level was correlated with total knowledge score, a correlation of 0.151 was obtained. This indicated a significant positive relationship between grade level and total knowledge score.

Twelfth graders scored significantly higher than tenth graders on general concept items dealing with the interdependence of nature; distribution and management of, and dependence upon natural resources; and pressures on recreational facilities.

When a chi square statistic was employed to test for large differences in the proportions of twelfth and tenth graders correctly answering the 70 knowledge items, no significant differences were found. However, several differences approached the .05 level of significance.

It can be assumed from the low correlation between

grade level and sex ($r = 0.012$), that these variables were independent. In other words, significant correlations of grade level to knowledge items were not a result of a disproportionate number of males to females in the tenth or twelfth grades.

Summary. Size of the community where students lived was highly correlated with the size of the community where they went to school. Therefore, busing of students was not considered to be an intervening variable.

In no case was there a significant correlation between size of community and responses to the 70 knowledge items or the total knowledge score.

Males scored significantly higher than females on several of the items requiring knowledge of specific facts and also on the total knowledge score. In no instance was there a significant correlation between sex and performance on general environmental concept items.

Twelfth graders scored significantly higher than tenth graders on several of the general environmental concept items and on the total knowledge score. Also, there was a significant positive correlation between grade level and correct responses on two items requiring knowledge of specific facts.

Correlation of Knowledge Variables with Total Knowledge Score

The 70 knowledge variables were correlated with the

total knowledge score. (See Table 27, p. 118.)

For ease of discussion, variables were grouped according to their correlations with the item in the group that correlated highest with the total knowledge score. (See Table 28, p. 119.) For example, all items which were significantly correlated with Variable 24 were grouped together. Group "A" includes items on Form A of the inventory; Group "B" includes items on Form B of the inventory; and Group "C" includes items on Form C of the inventory. Variable 19 was found on all three forms of the inventory.

It was noted that general environmental concept items were the highest correlates with the total knowledge score and comprised the majority of items in each of the groups.

Group A. Of the general environmental concept items found on Form A of the inventory, eight were significantly correlated with the total knowledge score and with Item 24 --the one in the group which correlated most highly with the total knowledge score. Three of the eight dealt with the interdependence, constant change, and limiting factors within the environment; two items asked about man's influence on the environment and his ability to control natural catastrophes; two dealt with the influence of population mobility on natural resources and the importance of outdoor recreation on our economy; and one asked the students to respond to the concept of essentials versus nonessentials.

Two environmental health items were also significantly

TABLE 27

KNOWLEDGE VARIABLES LISTED IN DESCENDING ORDER OF CORRELATION WITH TOTAL KNOWLEDGE SCORE

Variable Number	r	Variable Number	r
24	.463	33	.274
65	.434	31	.266
66	.428	30	.258
68	.418	2	.258
44	.414	13	.257
49	.414	37	.253
56	.411	11	.252
52	.404	62	.250
57	.396	41	.246
46	.394	47	.241
7	.386	59	.238
19	.386	18	.234
58	.380	10	.230
48	.374	6	.228
3	.366	50	.216
20	.366	9	.215
12	.361	38	.211
24	.359	5	.205
25	.356	4	.199
69	.349	14	.199
55	.349	53	.190
23	.343	28	.189
63	.340	1	.189
21	.340	8	.187
17	.335	39	.186
35	.332	15	.185
67	.325	61	.165
70	.319	51	.161
22	.307	54	.143
36	.304	40	.132
16	.295	29	.126
64	.290	32	.121
26	.281	27	.054
42	.279	60	.043
45	.277	43	-.001

TABLE 28

CORRELATIONS OF KNOWLEDGE VARIABLES WITH THAT VARIABLE WHICH CORRELATED HIGHEST WITH THE TOTAL KNOWLEDGE SCORE

Group	Variable Number	Correlation[a]	Correlation[b]
A	24	.463	1.000
A	3	.366	.139
A	7	.386	.141
A	12	.361	.112
A	17	.335	.199
A	19[c]	.386	.237
A	20	.366	.179
A	21	.340	.217
A	22	.307	.151
A	23	.343	.171
A	25	.356	.180
B	44	.414	1.000
B	19[c]	.386	.171
B	30	.258	.102
B	33	.274	.133
B	34	.359	.174
B	45	.277	.144
B	46	.394	.206
B	48	.374	.168
B	49	.414	.242
C	65	.434	1.000
C	19[c]	.386	.149
C	52	.404	.119
C	55	.349	.113
C	56	.411	.143
C	57	.396	.149
C	58	.380	.136
C	63	.340	.134
C	66	.428	.139
C	67	.325	.138
C	68	.418	.196
C	69	.349	.118
C	70	.319	.120

[a]Correlation of variable with total knowledge score.
[b]Correlation of variable with variable in that group which correlated highest with total knowledge score.
[c]Variable 19 was found on all three forms of the inventory.

correlated with the total knowledge score and with Variable 24. One item dealt with the relationship of population density to the incidence lung cancer. Another item asked for the identification of the major cause of death in the 18-24 age group.

An additional item in Group A required a comparison of population growth rates in various countries.

Group B. Of the general environmental concept items found on Form B of the inventory, six were significantly correlated with the total knowledge score and with Item 44--the one in the group which correlated most highly with the total knowledge score. Three of the six dealt with the management and distribution of natural resources and the relation of economic efficiency to resource conservation; one was about the interdependence of nature; one asked about hunting regulations for game control; and another item was about water as a reusable resource.

Three other items in Group B required specific knowledge of the environment. One item was about the source of sonic booms; one about the change of carbon dioxide content of the atmosphere due to the burning of fuels; and another item about venereal disease among persons 17-25 years of age.

Group C. Of the general environmental concept items found on Form C of the inventory, six were significantly correlated with the total knowledge score and with Item 65--

the one in the group which correlated most highly with the total knowledge score. Two of the six dealt with the interdependence of nature and natural resources; one with man being a product of heredity and environment; one with minerals as natural resources; one asked if economic and political strength is dependent on natural resources; and one with the pressure on recreational facilities due to increased amount of leisure time and improved means of transportation.

Other items in Group C required specific knowledge: All dealt with pollution problems; mine drainage, sources of thermal and air pollution, decomposition of wastes in water, the amount of solid wastes produced and the most economical means for its disposal.

Summary. Of the 70 knowledge items on the inventory, 67 had a significant positive correlation with the total knowledge score and each accounted for at least one percent ($r = 0.10$) of the total variance.

Groups A, B, and C were composed mostly of items dealing with general environmental concepts. Of the 39 knowledge items not found in these groups, almost all required specific knowledge and had a correlation with the total knowledge score of less than .277, the mean correlation of all items with the total knowledge score. In addition, most of these items were not significantly correlated with other items on the inventory. For their discussion refer to

Descriptive Analysis of Knowledge and Attitude Variables on page 70 .

Chi Square Analysis of Attitude Variables

Overview

Of the 88 items on the three forms of the inventory, 18 requested information from the respondent that could be classified as a reflection of attitudes. A list of the attitude variables, names, and position on the inventory is found in Appendix A, p. 143.

A chi square analysis using a computer program developed by Nie, Bent, and Hull (1970) was employed as one procedure to analyze response characteristics based on state of residence, sex, grade level, size of community where the school was located, and size of the community where the student lived. Due to a very large number of cases (3,000-10,264), small differences between cells with large numbers of cases produced large chi square values. In other words, small differences between large states produced larger chi square values than large differences between small states or large differences between a small and a large state. Results of these analyses are found in Tables 29-33.

To analyze differences between states holding numbers of cases as a constant, data were also analyzed by means of a chi square statistic using proportions. Significant differences which were found using this technique will be

TABLE 29

CHI SQUARE VALUES FOR ATTITUDE VARIABLES ASSOCIATED WITH STATE OF RESIDENCE

Variable Number	N	Degress of Freedom	X^2 using N	X^2 using prop.
1	10,211	30	131.98**	n.s.
2	10,014	30	112.76**	n.s.
3	3,578	20	24.44	n.s.
4	10,171	20	45.65**	n.s.
5	9,980	20	84.74**	n.s.
6	10,159	30	1273.76**	133.53[a]
7	10,121	30	255.95**	n.s.
8	10,117	30	221.23**	n.s.
9	10,147	20	40.95*	n.s.
10	10,155	20	69.59**	n.s.
11	10,133	20	64.52**	n.s.
12	10,013	20	17.31	n.s.
13	10,018	20	15.41	n.s.
14	10,102	20	38.15*	n.s.
15	6,596	20	18.80	n.s.
16	3,294	20	22.91	n.s.
17	3,246	30	57.19*	n.s.
18	3,178	20	28.91	n.s.

*Probability less than 0.01 using chi square with total N.
**Probability less than 0.001 using chi square with total N.
[a]Probability less than 0.05 using chi square for proportions.

TABLE 30

CHI SQUARE VALUES FOR ATTITUDE VARIABLES ASSOCIATED WITH SEX

Variable Number	N	Degrees of Freedom	X^2 using N	X^2 using prop.
1	10,116	3	19.12**	n.s.
2	9,920	3	12.29*	n.s.
3	3,540	2	15.30**	n.s.
4	10,073	2	108.30**	n.s.
5	9,886	2	74.78**	n.s.
6	10,062	3	22.94**	n.s.
7	10,023	3	93.30**	n.s.
8	10,020	3	61.03**	n.s.
9	10,049	2	2.13	n.s.
10	10,057	2	6.53	n.s.
11	10,035	2	38.22**	n.s.
12	10,018	2	42.37**	n.s.
13	10,021	2	63.87**	n.s.
14	10,005	2	43.33**	n.s.
15	6,536	2	3.46	n.s.
16	3,265	2	13.47*	n.s.
17	3,216	3	9.32	n.s.
18	3,149	2	12.00*	n.s.

* Probability less than 0.01 using chi square with total N.
** Probability less than 0.001 using chi square with total N.
a Probability less than 0.05 using chi square for proportions.

TABLE 31

CHI SQUARE VALUES FOR ATTITUDE VARIABLES ASSOCIATED WITH GRADE LEVEL

Variable Number	N	Degrees of Freedom	X^2 using N	X^2 using prop.
1	10,172	3	63.53**	n.s.
2	9,975	3	14.96*	n.s.
3	3,569	2	11.17*	n.s.
4	10,131	2	20.33**	n.s.
5	9,940	2	0.61	n.s.
6	10,019	3	1.03	n.s.
7	10,081	3	1.72	n.s.
8	10,077	3	7.36	n.s.
9	10,107	2	77.08**	n.s.
10	10,115	2	24.91**	n.s.
11	10,093	2	8.36	n.s.
12	10,074	2	18.74**	n.s.
13	10,077	2	7.55	n.s.
14	10,061	2	36.27**	n.s.
15	6,565	2	30.91**	n.s.
16	3,283	2	16.37**	n.s.
17	3,226	3	5.73	n.s.
18	3,158	2	6.81	n.s.

*Probability less than 0.01 using chi square with total N.
**Probability less than 0.001 using chi square with total N.
[a]Probability less than 0.05 using chi square with proportions.

TABLE 32

CHI SQUARE VALUES FOR ATTITUDE VARIABLES ASSOCIATED WITH SIZE OF COMMUNITY WHERE THE SCHOOL IS LOCATED

Variable Number	N	Degrees of Freedom	X^2 using N	X^2 using prop.
1	9,973	12	105.64**	n.s.
2	9,782	12	49.89**	n.s.
3	3,494	8	4.53	n.s.
4	9,935	8	29.77**	n.s.
5	9,751	8	20.33*	n.s.
6	9,925	12	441.51**	26.04[a]
7	9,890	12	481.81**	27.55[a]
8	9,883	12	348.88**	21.78[a]
9	9,914	8	11.45	n.s.
10	9,922	8	29.11**	n.s.
11	9,902	8	27.15**	n.s.
12	9,882	8	10.24	n.s.
13	9,883	8	10.92	n.s.
14	9,867	8	26.54**	n.s.
15	6,444	8	5.86	n.s.
16	3,228	8	9.97	n.s.
17	8,164	12	13.70	n.s.
18	3,096	8	21.81*	n.s.

*Probability less than 0.01 using chi square with total N.
**Probability less than 0.001 using chi square with total N.
[a]Probability less than 0.05 using chi square for proportions.

TABLE 33

CHI SQUARE VALUES FOR ATTITUDE VARIABLES ASSOCIATED WITH SIZE OF COMMUNITY WHERE THE STUDENTS LIVE

Variable Number	N	Degrees of Freedom	X^2 using N	X^2 using prop.
1	9,981	12	99.08**	n.s.
2	9,789	12	58.90**	n.s.
3	3,497	8	3.54	n.s.
4	9,944	8	27.84**	n.s.
5	9,761	8	12.69	n.s.
6	9,934	12	392.68**	23.15[a]
7	9,898	12	340.18**	n.s.
8	9,893	12	236.73**	n.s.
9	9,922	8	12.36	n.s.
10	9,930	8	29.27**	n.s.
11	9,912	8	26.73**	n.s.
12	9,891	8	6.97	n.s.
13	9,893	8	5.02	n.s.
14	9,877	8	16.69	n.s.
15	6,450	8	10.25	n.s.
16	3,226	8	13.43	n.s.
17	3,171	12	17.73	n.s.
18	3,103	8	15.29	n.s.

Probability less than 0.01 using chi square with total N.
Probability less than 0.001 using chi square with total N.
Probability less than 0.05 using chi square with proportions.

discussed in the following section.

State of Residence

Based on state of residence, significant differences were found in responses to the item asking what was considered to be the most serious environmental problem in the community (Attitude Variable 6). Tables 12, 13, 14, p. 82-83, report these differences.

Given the choices of air pollution, water pollution, solid waste disposal, and land use, 44.3 percent of California respondents chose air pollution as the major problem. The percentage of responses to air pollution ranged downward to where it was chosen by only 5 percent of the respondents from Hawaii.

Water pollution was of most concern to Wisconsin respondents, where 42.8 percent chose this as the major problem. California respondents chose water pollution as the major community problem only 7.1 percent of the time.

The community problem of waste disposal was considered to be most important by 35.9 percent of the respondents from Illinois and 17 percent of California respondents. Other states ranged between these two scores.

Land use as the major community problem was selected by 51.3 percent of respondents from Hawaii. On the other extreme, Alaska respondents selected this alternative only 11.8 percent of the time.

In brief summary, air pollution was considered to be the major problem in California; water pollution in Wisconsin; and land use in Hawaii. Scores were more consistent from state to state on the waste disposal alternative than responses on the other alternatives.

Differences found when calculating chi square values from the total number of cases and also proportions are reported in Table 29, p. 123.

Sex

Differences found when a chi square was calculated using the total number of cases and also proportions are reported in Table 30, p. 124. To investigate differences resulting from large variations in cell proportions rather than small variations in cells with large numbers of cases, a chi square using proportions was calculated. In this case, none of the resulting chi square values was found to be significant.

Grade Level

Reported in Table 31, p. 125 are differences in responses based on grade level when a chi square using the total number of cases and also proportions was calculated. When a chi square using proportions instead of the total number of cases was employed, no significant differences were found. In other words, significant chi square values using the total number of cases resulted from small

differences between cells with large numbers of cases rather than large variations in cell proportions.

Size of Community

Based on the size of community where the student lived and went to school, significant differences were found in responses to items asking what was considered to be the most serious environmental problem in the community (Attitude Variables 6, 7, 8).

When given the choices of air pollution, water pollution, solid waste disposal, and land use; students going to school and living in metropolitan areas considered air pollution as the major problem and those living in and attending schools in rural areas viewed land use and solid waste disposal as most important.

When students were given the opportunity to choose between pollution problems, crime, traffic accidents, and land use; there was a significant difference in responses depending on the size of the community where the student went to school. As the size of the community increased, the proportion of students selecting pollution problems and crime also increased. However, this trend was reversed in regard to pollution problems among respondents going to school in communities of over 100,000 population.

On another variable where students could choose between pollution problems and land use, crime, health problems, and

traffic accidents; there was a significant difference in responses depending on the size of community where the student went to school. As the size of the community where the student attended school decreased in size, there was an increase in the number of students who selected traffic accidents and health problems as being of most concern.

Differences found when a chi square was calculated using the total number of cases and also proportions are reported in Tables 32, 33; p. 126-127.

Summary

Based on chi square calculations using proportions, some environmental attitudes and concerns were significantly different based on state of residence, size of the community where the student lived, and size of the community where the student went to school. No differences in proportions were found based on the sex of the respondent, or grade level.

California respondents were concerned with air pollution significantly more than respondents from other states. Wisconsin students were significantly more concerned with water pollution than students from other states. Respondents from Hawaii viewed land use to be more of a problem than did other respondents.

Those living in metropolitan areas considered pollution and crime to be of major importance. However, an increasing trend of concern for pollution problems as communities

increased in size was reversed in cities of over 100,000.

Only significant differences obtained by the chi square analysis of proportions were discussed in this section. Other significant differences emerged when the total number of cases was used in the chi square calculations.

CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS, AND RECOMMENDATIONS

Summary

Most school systems have realized the importance of environmental education programs as part of their curriculum. However, due to a lack of research, many curricular decisions are being made on a questionable basis and with questionable results. Therefore, the purpose of this endeavor was to acquire baseline data about students' environmental knowledge and attitudes and to study their relationships to variables which would be of interest in evaluative measures.

Three forms of an inventory were developed which contained items requiring knowledge of specific facts and general concepts of the environment. Also, several items elicited students' attitudes about certain aspects of the environment.

The inventory was administered to a maximum of 30 tenth grade students and 30 twelfth grade students from 199

schools which were randomly selected from the Great Lakes states of Illinois, Indiana, Michigan, Ohio, and Wisconsin; and the Far West states of Alaska, California, Hawaii, Nevada, Oregon, and Washington.

With the aid of frequency counts and percentages, correlations, and chi square analyses, data were analyzed in an attempt to determine trends and relationships.

It was found that males did significantly better than females on items requiring knowledge of facts, but not on items dealing with general environmental concepts. Twelfth graders scored significantly higher than tenth graders on the environmental concept items, but not on the items requiring knowledge of environmental facts.

In regard to attitudes, differences were found based on sex and grade level. However, the calculation of a chi square statistic using proportions instead of the total number of cases indicated that the differences were slight.

The size of the community where respondents lived and went to school was not significantly related to knowledge of environmental facts and concepts, but was related to items requesting the respondent to identify what he thought to be the major environmental problem in his community. Using a forced choice technique, there was a positive relationship between the size of community and the selection of pollution as the major community problem. However, this trend was reversed in cities over 100,000 population.

State of residence was also related to what was considered to be the major environmental problem in the community. California respondents selected air pollution; Wisconsin respondents were more concerned with water pollution; and respondents from Hawaii considered land use to be the major concern.

Due to the large sample used in this study (10,264), no significant relationships went undetected. Also, where no relationships were found, it is not likely relationships existed. In calculating chi square values using proportions, samples were so large in most cases that the percentages could be considered very stable. Hence, a replication of the study whould provide similar results unless actual changes in population parameters have occurred.

Conclusions and Implications

In the following section, conclusions and implications which can be drawn from this survey will be discussed in relation to past research.

In comparing states on the environmental knowledge variables, responses were quite consistent, especially among the larger states with larger sample sizes. The mean knowledge scores for all states except Alaska, Hawaii, and Nevada ranged from 50.1-52.9. Apparently, the impact of state efforts in environmental education was not strong enough at

this time to be detected if their programs include areas which were part of this survey. Also, no relationship was found between the size of the community where the student lived and went to school and achievement on the knowledge part of the inventory.

When knowledge items were grouped by subject matter category, significant differences were found in the number of times states had the highest or lowest percentage correct.

The concern for the environment was found to differ from the consistency of environmental knowledge. Whereas it was determined that knowledge of the environment was not related to the size of the community, attitudes toward environmental problems were related. Results indicated a trend toward greater concern for pollution problems from respondents living in large communities, with the exception of those from cities of over 100,000 population. These results agree with those of recent opinion polls as reported by Erskine (1972). In a poll reported at that time, those in the suburbs were more concerned with pollution than those in the cities. Johnson (1972) obtained similar results in his survey of Los Angeles area residents. He found that middle and upper classes ranked air pollution as the number-one problem; while Blacks and Mexican-Americans viewed social problems to be of most concern. Since responses from minority groups tend to come from the larger cities, it can

be concluded that pollution problems compete with other more socially oriented problems among city dwellers.

This finding has implications for curriculum development in environmental education. From the survey conducted by the American Association of Health, Physical Education, and Recreation (1970), it was concluded that most environmental education programs have a traditional conservation-science approach. However, from the present study, it can be concluded that in larger cities there seem to be other competing factors which can also be classified as a legitimate part of "the environment." Social problems--man to man interactions--need to be included within environmental education programs if needs of inner city students are to be met.

Erskine (1972) also reported that the Midwest was more concerned with water pollution and that Westerners considered air pollution to be important. This finding can also be partially substantiated by results from this study. In comparing Far West states with states from the Great Lakes region, Wisconsin ranked highest in concern for water pollution, California ranked highest in concern for air pollution, and respondents from Hawaii considered land use to be of major importance. Apparently, people from various areas have special environmental concerns even though their knowledge of the environment tends to be relatively consistent with those from other parts of the country.

An ambiguous nature of environmental attitudes was also noted. On one hand, students disagreed with the statement that people have too much power in determining the way they live; and on the other hand, thought that present environmental problems could only be ameliorated by strong governmental controls. Most also felt that the quality of life for the future had precedence over the preservation of the freedom of the individual.

In regard to population problems, results indicated that such concerns were general and a definite lack of correspondence to personal actions was noted. The majority of respondents (69 percent) felt that population control and family planning were necessary if a satisfactory level of prosperity was to be maintained. However, very few (18 percent) thought that income tax exemptions for children should be decreased.

This agrees with Barnett's (1970) findings from a study of population attitudes. Over-population was viewed as a serious problem, but the expressed concern did not affect the family size of the respondents.

It can be concluded that environmental attitudes which tend to be broad in nature and possess little personal commitment are viewed favorably. However, when these attitudes become more specific and an obvious change in personal actions logically follows, individuals tend to remove the dissonance by not making the transfer from general to

specific or by changing personal attitud to correspond with their present actions.

Findings by Lynch and Chandle. 1970), and Wievel (1947) showed that males tended to achieve higher on environmental tests than did females. This was also the case in this study. However, upon examination, males scored higher on environmental knowledge items requiring recall of specific facts but not on items requiring knowledge of general environmental concepts. Such a finding might be explained in terms of differences in scientific background of males and females. As was found in surveys by Chin (1971) and Maben (1971), environmental education is usually taught in science classes. In addition, Wievel (1949) found that students who had taken natural science had higher achievement on an environmental test than those who didn't take the class. Also, males did better than females. Since science is a subject which is taken by a greater number of males than females, differences in exposure to environmental facts could result from such sources.

The relationship between grade level and achievement on environmentally related instruments has also been investigated by Brown (1971) and Wievel (1947). Brown reported an increase in drug knowledge of students from fifth to tenth grade, and a plateau from tenth to twelfth. On an environmental achievement test, Wievel found that high school seniors scored higher than freshmen.

In the present study, it was found that twelfth grade students scored significantly higher than tenth grade students on several knowledge variables and on the total knowledge score. The differences between tenth and twelfth graders were found to exist on that part of the inventory which dealt with general environmental concepts, and not on the part requiring recall of specific facts. One cannot automatically attribute the increase in conceptual understanding to environmental education programs since many variables interact with the student during this two year period.

Twelfth graders did no better than tenth graders in recall of environmental facts. Since males scored higher than females in recall of environmental facts, it might be concluded that tenth grade males as well as twelfth grade males scored higher on specific knowledge than females but were not significantly different from each other. A further investigation comparing both males and females in both tenth and twelfth grades would add substantially to an explanation of results obtained in this study.

Recommendations

Since this survey was an attempt to gather baseline data, further research could accomplish several objectives. The extension of this or a similar study might include the following points:

(1) Schools which are involved in environmentally oriented curricula need to be compared to those schools without such an emphasis. This can be accomplished on a local or national level with data already available from this survey. Each participating school in this study will eventually receive their school's results as well as have access to state and national norms.

(2) How do results from the Great Lakes states and Far West states compare with those of other regions of the United States? The design of the overall survey, of which this study is the initial part, will include sampling all 50 states and the District of Columbia. Comparisons need to be made when research on the other regions is complete.

(3) A further view of the relationship between knowledge and attitudes is needed. In the present study, environmental knowledge seemed to be quite consistent throughout the two regions of the United States, but environmental concerns were not. An attempt to relate those concerns to geographical locations having increased knowledge of the issue was not successful. In research cited by Brown (1971) and Tichenor, et al (1972), it was found that as knowledge increased, favorable health and environmental attitudes decreased. In teaching favorable attitudes, it would be important to know just how an increase in knowledge about the details of the issues might affect attitudes toward those issues. If no relationship or a negative relationship were

found, favorable attitude change via knowledge would be seriously questioned.

Such a study could be conducted by sampling the data base made available through the present study.

(4) A further investigation might attempt to explain why males do better than females on factual material about the environmental and why twelfth graders do better than tenth graders on items concerned with environmental concepts.

(5) A relationship between attitudes and behaviors should be investigated. Presently, it is assumed that a relationship does exist. However, if it were determined that behaviors of those with favorable environmental attitudes do not differ significantly from those whose attitudes are not considered favorable; those programs which attempt to alter attitudes in hope of changing behavior would need re-evaluation.

(6) A similar study, conducted in the future, would give a further indication of trends. Since a similar study has not been previously conducted, changes in general knowledge and attitudes of the population of high school students can only be surmised.

(7) Data made available through this and its related studies by Bohl and Rondeau provide a source for future research--either through the use of the total data base or a sample therefrom.

APPENDIX A

Numbers, Position on Inventory, and Names of Knowledge Variables

Numbers, Position on Inventory, and Names of Attitude Variables

TABLE 34

NUMBERS, POSITION ON INVENTORY, AND NAMES OF KNOWLEDGE VARIABLES

Variable Number	Position on Inventory	Variable Name
1	A-1	Shift in land use
2	A-2	New energy sources
3	A-3	Population growth rate
4	A-4	Radioactive wastes
5	A-5	Exposure to radiation
6	A-6	Persistence of DDT
7	A-7	Lung cancer deaths
8	A-8	Metal reserves
9	A-9	Water pollution by industry
10	A-10	Elimination of water pollution
11	A-11	Underground water resource
12	A-12	Death in the 18-24 age group
13	A-13	Drug abuse
14	A-14	Particle pollution
15	A-15	Air pollutants by weight
16	A-18	Accidental injuries in the 1-30 age group
17	A-19	Catastrophe prevention
18	A-20	Hearing damage
19	A-21, B-21, C-21	Interdepence of living things
20	A-22	Man's effect on the environment

TABLE 34, cont.

Variable Number	Position on Inventory	Variable Name
21	A-23	Population mobility
22	A-24	Outdoor recreation
23	A-25	Essentials versus nonessentials
24	A-26	Limiting factors
25	A-27	Constant change of the environment
26	B-1	Source of manmade radiation
27	B-2	Federal land ownership
28	B-3	World population
29	B-4	Coal reserves
30	B-5	Carbon dioxide in the air
31	B-6	Production of solid wastes
32	B-7	Phosphate pollution
33	B-8	Diseases of 17-25 age group
34	B-9	Sonic booms
35	B-10	Inversions
36	B-11	Solid waste disposal
37	B-12	Location of accidents
38	B-13	Home water use
39	B-14	Decomposition and diffusion of pollutants
40	B-15	Home electrical power use
41	B-16, C-20	U.S. consumption of raw materials

TABLE 34, cont.

Variable Number	Position on Inventory	Variable Name
42	B-19, C-19	Nonrenewable resources
43	B-20	Oil pollution of the oceans
44	B-22	Management of natural resources
45	B-23	Hunting regulation to maintain game populations
46	B-24	Economic efficiency and conservation of a natural resource
47	B-25	Natural and manmade processes producing pollutants
48	B-26	Distribution of resources
49	B-27	Water as a reusable resource
50	C-1	Natural gas reserves
51	C-2	Population of urban areas
52	C-3	Biodegradable materials
53	C-4	Harmful products of air pollution
54	C-5	Population growth in other countries
55	C-6	Refuse collection
56	C-8	Decomposition in water removes oxygen
57	C-9	Mine drainage
58	C-10	Thermal pollution
59	C-11	Sewers and treatment plants
60	C-12	Noise pollution

TABLE 34, cont.

Variable Number	Position on Inventory	Variable Name
61	C-13	Thickness of earth's atmosphere
62	C-14	Causes of fatal traffic accidents
63	C-16	Sources of air pollution
64	C-22	Man's ability to change the environment
65	C-23	Demands on recreational facilities
66	C-24	Political and economic strength depends on natural resources
67	C-25	Interdependence of natural resources
68	C-26	Heredity and environment
69	C-27	Nonrenewable resources
70	C-15	Disposing of municipal solid wastes

TABLE 35

NUMBERS, POSITION ON INVENTORY, AND NAMES OF ATTITUDE VARIABLES

Variable Number	Position on Inventory	Variable Name
1	A-16, B-17, C-17	Areas of pollution and construction
2	A-17, B-18, C-18	Drug abuse
3	A-28	Rights of others
4	A-29, B-29, C-29	Governmental controls to reduce pollution
5	A-30, B-30, C-30	Tax exemptions for children
6	A-31, B-31, C-31	Community problems
7	A-32, B-32, C-32	Community problems
8	A-33, B-33, C-33	Community problems
9	A-34, B-34, C-34	Individual rights
10	A-35, B-35, C-35	Environmental concern of farmers and suburbanites
11	A-36, B-36, C-36	Environmental concern of suburbanites and city dwellers
12	A-37, B-37, C-37	Individual rights versus environmental laws
13	A-38, B-38, C-38	Industrial pollution
14	A-39, B-39, C-39	Industrial pollution controls
15	B-28, C-28	Family planning
16	B-40	Land use planning
17	C-7	Fluoride in water supply
18	C-40	Housing

APPENDIX B

Initial Letter to Principal

Follow-up Letter to Positive Respondents not Sending in Completed Test Materials

Follow-up Letter to Nonrespondents

THE OHIO STATE UNIVERSITY
COLLEGE OF EDUCATION
1945 NORTH HIGH STREET
COLUMBUS, OHIO 43210

FACULTY OF SCIENCE AND TECHNOLOGICAL EDUCATION

(614) 422-6121

Dear Principal:

The ERIC Clearinghouse for Science, Mathematics, and Environmental Education located at The Ohio State University is a national information center funded by several government agencies including the United States Office of Education, the Environmental Protection Agency, and the National Science Foundation. Information on the Clearinghouse is enclosed.

Since the Clearinghouse has been responsible for environmental education, it has received many requests for information regarding secondary school students' knowledge, concepts, attitudes, and values regarding the environment. These requests have come from school administrators, curriculum development personnel, citizens' groups, and others.

To assist the Clearinghouse in obtaining such information the Center for Science and Mathematics Education at The Ohio State University has tabulated the types of requests and developed an inventory to assess selected knowledge, concepts, attitudes, and values regarding the environment. The inventory has been divided into three separate forms. Each form contains some items common to all three forms, but also a number of different items. Thus, while a student completes only one form, the information he provides can be compared with data from other students. Samples of all forms are enclosed.

To obtain information on a national basis we have randomly selected a sample of secondary schools. Your school was selected in the process. We are requesting that you participate in the survey to assist us in the study.

We are requesting that each school obtain information from 30 sophomores and 30 seniors. We would like to obtain a random sample from the student population. If this is not possible, then we would appreciate receiving information from a representative sophomore and senior class. Student responses will not include their names, so the individual is protected. While we will know the school source, no information regarding individual schools will be disclosed.

We will tabulate the student responses and return to each participating school the responses of the students from that school.

We believe the results of the survey will provide very useful information regarding selected knowledge, concepts, attitudes, and values of secondary school students. Technical reports regarding the survey will be made available through the ERIC system.

A form to indicate if your school will participate is attached with an addressed return envelope. Please return the form whether you can or can not participate. If you agree to participate, you will receive inventories and administration directions by return mail.

We look forward to working with you on this project and hope that you can participate.

Sincerely,

Robert W. Howe

Robert W. Howe
Professor and Chairman

RWH:lsh

Enclosures

THE OHIO STATE UNIVERSITY
COLLEGE OF EDUCATION
1945 NORTH HIGH STREET
COLUMBUS, OHIO 43210

FACULTY OF SCIENCE AND MATHEMATICS EDUCATION

(614) 422-4121

TO: Dr. Robert W. Howe
Center for Science and Mathematics Education
The Ohio State University
1945 North High Street
Columbus, Ohio 43210

FROM: Name _____

Position _____

School _____

City _____ State _____ Zip _____

Please check the appropriate space.

_____ 1. We will participate in the survey. Please send inventories and directions for administration. (If you check 1, please check a or b)

_____ a. We will select a random sample from our students.

_____ b. We will select a representative 10th grade class and a representative 12th grade class.

_____ 2. We are interested in participating, but permission must be requested. Request permission from:

Name _____

Position _____

Street Address _____

City _____ State _____ Zip _____

_____ 3. We are not able to participate in the survey.

THE OHIO STATE UNIVERSITY
April 11, 1973

Dear

Several weeks ago you indicated that your school would be willing to participate in a National Environmental Survey conducted by the ERIC Clearinghouse of Science, Mathematics, and Environmental Education and the Center of Science and Mathematics Education at The Ohio State University. We sent you a packet of materials, including answer sheets which you were to return.

As of yet we have not received the answer sheets and thought perhaps they did not arrive or were forgotten. Please notify us if more inventories are needed.

We would appreciate your participation.

Sincerely yours,

A. Cordell Perkes

A. Cordell Perkes, Research Associate
Department of Science Education
The Ohio State University
Columbus, Ohio 43210

THE OHIO STATE UNIVERSITY

Dear Principal:

We recently sent you a letter indicating that your school had been selected as a part of a random sample for a national study regarding student knowledge and attitudes regarding the environment. Enclosed were samples of instruments to be used and a response form to return indicating if you would be able to participate. To date, we have not received your response.

We have had an excellent response and hope to complete school activities in March or early April. Hence, we need to know if you will be able to participate. (If your school cannot, we need to inform alternate schools that we will use information from their schools.)

A response form and a stamped envelope are enclosed for your convenience. If you did not receive the sample materials mailed to you, but are interested in participating, let us know and we will send another set of sample materials.

Sincerely,

Robert W. Howe

Robert W. Howe
Professor and Chairman

RWH/jkd

Enclosures

THE OHIO STATE UNIVERSITY
COLLEGE OF EDUCATION
1945 NORTH HIGH STREET
COLUMBUS, OHIO 43210

FACULTY OF SCIENCE AND MATHEMATICS EDUCATION

(614) 422-4121

TO: Dr. Robert W. Howe
Center for Science and Mathematics Education
The Ohio State University
1945 North High Street
Columbus, Ohio 43210

FROM: Name _____

Position _____

School _____

City _____ State _____ Zip _____

Please check the appropriate space.

____ 1. We will participate in the survey. Please send inventories and directions for administration. (If you check 1, please check a or b)

____ a. We will select a random sample from our students.

____ b. We will select a representative 10th grade class and a representative 12th grade class.

____ 2. We are interested in participating, but permission must be requested. Request permission from:

Name _____

Position _____

Street Address _____

City _____ State _____ Zip _____

____ 3. We are not able to participate in the survey.

APPENDIX C

Inventory A and Answer Key

Inventory B and Answer Key

Inventory C and Answer Key

Directions for Inventory Administration--Random Sample

Directions for Inventory Administration--Representative Sample

Inventory A

Directions

Read each item and mark the answer which you believe provides the best answer to the question or the statement on the answer sheet provided. (If you are not provided with an answer sheet, mark your answer on the inventory in the space provided.)

1. Land use in the U.S. is shifting from

___ (a) urban to rural
_X_ (b) rural to suburban
_X_ (c) suburban to urban
___ (d) suburban to rural

2. Research and technical break-throughs have demonstrated that energy can be obtained on a large scale from which of the following sources?

_X_ (a) solar energy
___ (b) tidal generation
___ (c) geothermal sources
___ (d) none of the above

3. The U.S. population is growing at a rate which is

_X_ (a) less than that of most of the rest of the world
___ (b) at about the same rate as that of most of the rest of the world
___ (c) at a rate more rapid than that of most of the rest of the world

4. Wastes from nuclear power plants which are high in radioactivity are currently

___ (a) lost into the air
___ (b) discharged into water sources such as rivers and lakes
_X_ (c) concentrated and stored in liquid form
_X_ (d) concentrated and stored in solid form

A-2

5. Most of the radiation to which the average American is exposed is due to

___ (a) occupational hazards
___ (b) TV sets and luminous wrist watches
___ (c) medical sources (X-rays, etc.)
_x_ (d) radiation from natural sources

6. DDT is a pesticide which

___ (a) is non-persistent, remains toxic from several days to about 15 weeks
___ (b) is moderately persistent, remains toxic from one year to two years
_x_ (c) is persistent, remains toxic for many years
___ (d) is permanently toxic

7. Death in the United States due to lung cancer is greatest in

___ (a) rural areas
___ (b) cities of less than 250,000 people
___ (c) cities of 250,000 to 1,000,000
_x_ (d) cities over 1,000,000

8. At today's rate of consumption known reserves of zinc, lead, tin, petroleum, and copper will be depleted in

___ (a) 10 years
___ (b) 20 years
_x_ (c) 40 years
___ (d) 80 years

9. Industry is responsible for what percent of the water pollution?

___ (a) 95%
_x_ (b) 65%
___ (c) 45%
___ (d) 25%

A-3

10. The Environmental Protection Agency estimates that industry can currently remove what percent of pollution discharged into water

___ (a) 100%
_x_ (b) 85%
___ (c) 65%
___ (d) 50%

11. North Americans are removing fresh water from underground sources

___ (a) half as fast as it is being replaced
___ (b) at about the same rate as it is being replaced
_x_ (c) twice as fast as it is being replaced
___ (d) four times as fast as it is being replaced

12. The major cause of death in the 18-24 age group is

___ (a) suicide
_x_ (b) auto accidents
___ (c) sickness and disease
___ (d) drugs

13. The non-medical use of drugs in the U.S. is

_x_ (a) increasing
___ (b) about constant
___ (c) decreasing but receiving more publicity
___ (d) decreasing

14. Particle pollution (increase in soot, dust, etc.) in the atmosphere has a tendency to

___ (a) increase the earth's temperature
_x_ (b) decrease the earth's temperature
___ (c) stabilize the earth's temperature

15. The major air pollutant discharged into the air by weight is

___ (a) nitrogen oxide
___ (b) sulfur oxide
___ (c) particulates
_x_ (d) carbon monoxide

A-4

16. Where do you believe we have the areas of worst pollution and ugliest construction?

___ (a) cities
___ (b) suburbs
___ (c) villages
___ (d) rural areas

17. Non-medicinal use of drugs would decline if we

___ (a) passed and enforced stricter laws
___ (b) made the use of drugs legal
___ (c) enforced present laws
___ (d) none of the above

18. Injuries caused by accidents are the leading cause of death in which of the following age groups?

X (a) 1 through 30
___ (b) 30 through 60
___ (c) over 60 years
___ (d) all of these

19. Man can prevent most natural environmental problems such as hurricanes, volcanic eruptions, and earth quakes

___ (a) true
X (b) false

20. Research data indicate that physiological hearing damage begins at an exposure to

___ (a) 40 decibels
X (b) 85 decibels
X (c) 120 decibels
___ (d) 210 decibels

Directions

Read each item and mark the answer which you believe provides the best answer to the question or the statement on the answer sheet provided. (If you are not provided with an answer sheet, mark your answer on the inventory in the space provided.)

21. Living things are interdependent with one another and with their environment.
_x_(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

22. Man has affected environmental processes in a negative way.
_x_(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

23. Increased population mobility is changing the nature of demands upon some resources.
_x_(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

24. Outdoor recreation is an increasingly important part of our culture and our economy.
_x_(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

25. Choices between human needs (essentials) and human wants or desires (nonessentials) must be considered if we are to improve our quality of life.
_x_(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

26. In any environment, one component like water, air, or food may limit the type of life which can survive.
_x_(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

27. Organisms and environments are in constant change.
_x_(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

28. Man has responsibility to develop an appreciation of and respect for the rights of others.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

29. Only strong governmental controls will reduce pollution problems.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

30. Each parent is currently allowed to deduct several hundred dollars from their taxable income for each child in their family. I would vote

___ (1) increase the tax exemption (allowance) per child
___ (2) decrease the tax exemption (allowance) per child
___ (3) leave the tax exemption (allowance) per child as it is

A-6

31. Which of the following problems is most serious in your community?

___ (1) air pollution
___ (2) water pollution
___ (3) solid waste disposal
___ (4) land use

32. Which of the following problems is most serious in your community?

___ (1) pollution problems
___ (2) land use
___ (3) crime
___ (4) traffic accidents

33. Which of the following problems is most serious in your community?

___ (1) pollution problems and land use
___ (2) crime
___ (3) health problems
___ (4) traffic accidents

34. An individual has too much power in determining the way he lives.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

35. Farmers are generally more concerned about environmental problems than are people who live in the suburbs.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

36. People who live in the suburbs generally are more concerned about environmental problems than are people who live in the inner city.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

37. It is more important to preserve the freedom of the individual's choice than to enforce laws to protect the quality of life in the future.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

38. Industries should not be allowed to contribute to pollution - either through production or with the end product.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

39. Controls should be placed on industry which will protect the environment even if it means things will cost more.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

Inventory B

Directions

Read each item and mark the answer which you believe provides the best answer to the question or the statement on the answer sheet provided. (If you are not provided with an answer sheet, mark your answer on the inventory in the space provided.)

1. The largest single source of manmade radiation to which the average American is exposed is

___ (a) occupational hazards
___ (b) nuclear power plant radiation
_x_ (c) TV sets and luminous wrist watches
___ (d) medical use

2. The Federal government owns approximately what percent of the land?

___ (a) 10%
___ (b) 35%
_x_ (c) 60%
___ (d) 85%

3. The population of the world increased from 2 billion in 1930 to about

___ (a) 2.5 billion by 1970
___ (b) 3.0 billion by 1970
_x_ (c) 3.5 billion by 1970
___ (d) 4.0 billion by 1970

4. The known supply of coal is estimated to be adequate for

___ (a) 3 years
___ (b) 30 years
_x_ (c) 300 years
___ (d) 3000 years

5. Due to the burning of fuels, the carbon dioxide content of the atmosphere has

_x_ (a) increased several times
_x_ (b) increased slightly
___ (c) remained the same
___ (d) decreased

B-2

6. Most solid wastes are produced by

___ (a) industrial operations
_X_ (b) residential operations
___ (c) commercial operations
___ (d) agricultural operations

7. The largest amount of useable phosphates which reaches bodies of water comes from

___ (a) municipal sources
___ (b) industrial sources
_X_ (c) farms
___ (d) boats

8. Which of the following diseases occurs most frequently among persons in the U.S. between 17-25?

___ (a) cancer
_X_ (b) venereal disease
___ (c) tuberculosis
___ (d) heart disease

9. Sonic booms are caused by aircraft that

___ (a) fly high
___ (b) are large
___ (c) fly low
_X_ (d) fly fast

10. An inversion can be harmful in that it

___ (a) increases carbon dioxide in the air
_X_ (b) causes pollution to stay near the ground
___ (c) reduces horizontal air movement

11. At present, the most economical way of disposal of solid wastes is

___ (a) incineration
___ (b) recycling
_X_ (c) sanitary landfill

B-3

12. Most accidental deaths and injuries occur in which location?

___ (a) on the highways
_X_ (b) in the home
___ (c) at work
___ (d) in public places

13. Each person in the United States uses approximately how many gallons of water per day for home use?

___ (a) 10
_X_ (b) 50
___ (c) 100
___ (d) 200

14. Most pollutants eventually decompose and diffuse throughout the environment

_X_ (a) true
___ (b) false

15. Approximately how much of the Nation's electrical power supply produced is consumed in our homes?

___ (a) 10%
_X_ (b) 25%
___ (c) 50%

16. The United States has about 6% of the world's population and consumes approximately what percent of the non-renewable raw materials processed each day?

___ (a) 5%
___ (b) 10%
___ (c) 25%
_X_ (d) 50%

17. Where do you believe we have the areas of worst pollution and ugliest construction?

___ (a) cities
___ (b) suburbs
___ (c) villages
___ (d) rural areas

B-4

18. Non-medicinal use of drugs would decline if we.

___ (a) passed and enforced stricter laws
___ (b) made the use of drugs legal
___ (c) enforced present laws
___ (d) none of the above

19. Which of the following are non-renewable resources?

___ (a) wood and paper
_x_ (b) iron and copper
_x_ (c) water and air
___ (d) animals

20. Which of the following is the major source of oil pollution in the oceans?

___ (a) offshore drilling
___ (b) oil tanker operations
_x_ (c) motor vehicle waste
___ (d) refineries

B-5

Directions

Read each item and mark the answer which you believe provides the best answer to the question or the statement on the answer sheet provided. (If you are not provided with an answer sheet, mark your answer on the inventory in the space provided.)

21. Living things are interdependent with one another and with their environment.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

22. The management of natural resources to meet the needs of successive generations demands long range planning.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

23. Hunting regulations are useful in maintaining game populations.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

24. Economic efficiency does not always result in conservation of a natural resource.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

25. Pollutants are produced by both natural and manmade processes.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

26. Natural resources are unequally distributed with respect to land areas and political boundaries.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

27. Water is a reusable resource but the available quantity may be reduced or the quality impaired.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

28. Family planning and the limiting of family size is important if over population is to be avoided and a reasonable standard of living assured for future generations.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

29. Only strong governmental controls will reduce pollution problems.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

30. Each parent is currently allowed to deduct several hundred dollars from their taxable income for each child in their family. I would vote

___ (1) increase the tax exemption (allowance) per child
___ (2) decrease the tax exemption (allowance) per child
___ (3) leave the tax exemption (allowance) per child as it is

31. Which of the following problems is most serious in your community?

___ (1) air pollution
___ (2) water pollution
___ (3) solid waste disposal
___ (4) land use

32. Which of the following problems is most serious in your community?

___ (1) pollution problems
___ (2) land use
___ (3) crime
___ (4) traffic accidents

33. Which of the following problems is most serious in your community?

___ (1) pollution problems and land use
___ (2) crime
___ (3) health problems
___ (4) traffic accidents

34. An individual has too much power in determining the way he lives.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

35. Farmers are generally more concerned about environmental problems than are people who live in the suburbs.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

36. People who live in the suburbs generally are more concerned about environmental problems than are people who live in the inner city.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

B-7

37. It is more important to preserve the freedom of the individual's choice than to enforce laws to protect the quality of life in the future.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

38. Industries should not be allowed to contribute to pollution - either through production or with the end product.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

39. Controls should be placed on industry which will protect the environment even if it means things will cost more.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

40. Comprehensive planning that considers both controlled growth and development is the only way to improve land use.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

Inventory C

Directions

Read each item and mark the answer which you believe provides the best answer to the question or the statement on the answer sheet provided. (If you are not provided with an answer sheet, mark your answer on the inventory in the space provided.)

1. The known supply of natural gas is currently estimated to be adequate for

___ (a) 3 years
X (b) 13 years
X (c) 33 years
___ (d) 133 years

2. The number of people in the United States currently living in urban areas is estimated to be

___ (a) 27%
___ (b) 47%
X (c) 67%
___ (d) 87%

3. Which of the following materials is not biodegradable?

___ (a) leaves
___ (b) bread
___ (c) wood
X (d) glass

4. Which of the following products is considered the most harmful product of air pollution?

___ (a) carbon dioxide
___ (b) sulfur dioxide
X (c) carbon monoxide
___ (d) ammonia

5. Populations are increasing most rapidly in

___ (a) highly industrialized countries
X (b) countries just becoming industrialized
___ (c) underdeveloped countries
___ (d) agricultural countries

C-2

6. Refuse collected in urban areas of the U.S. was about 2.75 pounds per week per person in 1920. It is now about

___ (a) 1.5 pound per person
___ (b) 2 pounds per person
___ (c) 5 pounds per person
_x_ (d) 10 pounds per person

7. Adding fluorides in the water supply for the purpose of strengthening teeth

___ (a) should be mandatory by law
___ (b) should be optional by local vote
___ (c) should not be allowed

8. Many organic wastes in water are decomposed. In the process, what material is removed from the water?

___ (a) carbon dioxide
_x_ (b) oxygen
___ (c) hydrogen
___ (d) sulphur

9. Water drainage from mines is a significant source of water pollution in which area?

___ (a) the Northwest United States
___ (b) the Southwest United States
___ (c) Alaska
_x_ (d) the Appalachian area of the United States

10. The chief industrial source of thermal pollution of water is the

_x_ (a) electric power industry
___ (b) rubber and plastic industry
___ (c) textile industry
___ (d) paper industry

11. What percent of the Nation's population is served by adequate sewers and treatment plants?

___ (a) more than 90%
___ (b) more than 70%
___ (c) about 50%
_x_ (d) less than 40%

C-3

12. Recent data indicate that the number of people in the United States exposed to potentially hazardous noise is

___ (a) 3 million
_X_ (b) 15 million
___ (c) 40 million
___ (d) 75 million

13. The atmosphere, the layer of air surrounding the earth, is about

___ (a) 5 miles thick.
_X_ (b) 20 miles thick
___ (c) 40 miles thick
___ (d) 80 miles thick

14. Which of the following has been a major factor in about 50 percent of fatal auto accidents?

_X_ (a) drinking
___ (b) mechanical problems with the car
___ (c) excess speed
___ (d) bad weather conditions

15. Which technique of disposing of municipal solid wastes is normally <u>least</u> in dollar costs?

_X_ (a) sanitary landfill
___ (b) incineration
___ (c) composting
_X_ (d) open dump with burning

16. The greatest source of air pollution is

_X_ (a) transportation
___ (b) industrial processes
___ (c) solid waste disposal
___ (d) homes

17. Where do you believe we have the areas of worst pollution and ugliest construction?

___ (a) cities
___ (b) suburbs
___ (c) villages
___ (d) rural areas

18. Non-medicinal use of drugs would decline if we

___ (a) passed and enforced stricter laws
___ (b) made the use of drugs legal
___ (c) enforced present laws
___ (d) none of the above

C-4

19. Which of the following are non-renewable resources?

___ (a) wood and paper
_X_ (b) iron and copper
_X_ (c) water and air
___ (d) animals

20. The United States has about 6% of the world's population and consumes approximately what percent of the non-renewable raw materials consumed each day in the world?

___ (a) 5%
___ (b) 10%
___ (c) 25%
_X_ (d) 50%

C-5

Directions

Read each item and mark the answer which you believe provides the best answer to the question or the statement on the answer sheet provided. (If you are not provided with an answer sheet, mark your answer on the inventory in the space provided.)

21. Living things are interdependent with one another and their environment.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

22. Man has the ability to manipulate and to change the environment.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

23. Increased leisure time and improved transportation have created heavy pressures on existing recreation facilities and demands for new ones.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

24. Continued political and economic strength of a country is, in part, dependent upon the natural resources to which it has access.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

25. Natural resources are interdependent and the use or misuse of one will affect others.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

26. An organism is a product of its heredity and environment.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

27. Minerals are nonrenewable resources.
X (1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

28. Family planning and the limiting of family size is important if over population is to be avoided and a reasonable standard of living assured for future generations.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

29. Only strong governmental controls will reduce pollution problems.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

30. Each parent is currently allowed to deduct several hundred dollars from their taxable income for each child in their family. I would vote

___ (1) increase the tax exemption (allowance) per child
___ (2) decrease the tax exemption (allowance) per child
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___ (1) air pollution
___ (2) water pollution
___ (3) solid waste disposal
___ (4) land use

32. Which of the following problems is most serious in your community?

___ (1) pollution problems
___ (2) land use
___ (3) crime
___ (4) traffic accidents

33. Which of the following problems is most serious in your community?

___ (1) pollution problems and land use
___ (2) crime
___ (3) health problems
___ (4) traffic accidents

34. An individual has too much power in determining the way he lives.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

35. Farmers are generally more concerned about environmental problems than are people who live in the suburbs.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

36. People who live in the suburbs generally are more concerned about environmental problems than are people who live in the inner city.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

C-7

37. It is more important to preserve the freedom of the individual's choice than to enforce laws to protect the quality of life in the future.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

38. Industries should not be allowed to contribute to pollution - either through production or with the end product.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

39. Controls should be placed on industry which will protect the environment even if it means things will cost more.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

40. The single most important environmental element and also the area of greatest need is housing.
__(1) Agree __(2) Neutral __(3) Disagree __(4) No Opinion

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Columbus, Ohio 43210

DIRECTIONS FOR ADMINISTERING ENVIRONMENTAL KNOWLEDGE AND ATTITUDE INVENTORY (FOR RANDOM SAMPLES)

Content of Packet

This packet should contain two sets of thirty (30) inventories and two sets of thirty (30) answer sheets. One set is to be used with a random sample of tenth grade students. One set is to be used with a random sample of twelfth grade students. Each set of instruments contains ten (10) copies of Form A, ten (10) copies of Form B, and ten (10) copies of Form C.

Time Required to Administer the Inventory

While time to complete the inventory varies with individuals, most students complete the form in about thirty minutes. If they finish earlier, they should be encouraged to review their responses.

Random Selection of Students

1) Selection of Tenth Grade Students

Place numbers representing the total number of tenth grade students in your school in a container and draw thirty (30) numbers. Then, use these numbers to identify the students from an alphabetically arranged classlist. (If you have only thirty or fewer students in the tenth grade, then all students should be included.) If number two (2) is drawn, the second student on your list would be selected; if number ten (10) is drawn, the tenth student on your list should be selected. Continue the procedure until all students are selected.

2) Selection of Twelfth Grade Students

Use the same procedure as presented above for the tenth grade.

Administration of the Instruments

1) Identify a person to administer the inventory for each grade level.

2) Students at each grade level should all meet together for administration of the inventories.

3) Before you distribute the inventory booklets and answer sheets, have the students count off 1, 2, 3. All 1's should complete Form A; all 2's should complete Form B; all 3's should complete Form C.

4) Distribute inventories and answer sheets.

(over please...)

5) Be certain each student has a No. 2½ or softer pencil.

6) Provide students with information for the population of the community (city, town, etc.) in which the school is located. From the list below, select the number that best describes the location of your school. Give the students the number to mark on their answer sheet in the space for Item 50.

1: Community of 1-1,000
2: Community of 1,000-10,000
3: Community of 10,000-50,000
4: Community of 50,000-100,000
5: Community of 100,000 and over

7) Have the students select the number that best describes the location of their home. Read the descriptions and the numbers to the students. They should place the number on their answer sheet in the space for Item 51. Which best describes the location of your home?

1: Community of 1-1,000
2: Community of 1,000-10,000
3: Community of 10,000-50,000
4: Community of 50,000-100,000
5: Community of 100,000 and over

8) Have the students indicate whether they are tenth or twelfth graders. If they are in grade 10, mark response 1 in the space provided for Item 52. If they are in grade 12, mark response 2 in the space provided for Item 52.

9) Have the students indicate whether they are male or female by marking M or F in space provided under SEX on the form.

10) Have the students indicate their ages by darkening the correct spaces in the first two columns under SECTION NUMBER. If a person is sixteen years old, he would darken 1 in the first column and 6 in the second column.

11) Have the students fill in the school identification number on their answer sheet in the space marked CAMPUS. Your school identification number is _____.

12) Have the students indicate which form they are completing by marking the appropriate space under TEST FORM. Those completing Form A should darken A; those completing Form B should darken B; those completing Form C should darken C.

13) INSTRUCTIONS FOR MARKING THE ANSWER SHEET:

Students should mark the space that corresponds to their answer for each item. The space marked should be completely darkened. If an answer is to be changed, it should be completely erased; wrong answers should not be crossed out. The answer sheets will be scored electronically, so following these directions is very important. For multiple choice items, response a or 1 should be marked in column 1; b or 2 in column 2; c or 3 in column 3; d or 4 in column 4; and e or 5 in column 5.

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DIRECTIONS FOR ADMINISTERING ENVIRONMENTAL KNOWLEDGE AND ATTITUDE INVENTORY (FOR RANDOM SAMPLES)

Content of Packet

This packet should contain two sets of thirty (30) inventories and two sets of thirty (30) answer sheets. One set is to be used with a random sample of tenth grade students. One set is to be used with a random sample of twelfth grade students. Each set of instruments contains ten (10) copies of Form A, ten (10) copies of Form B, and ten (10) copies of Form C.

Time Required to Administer the Inventory

While time to complete the inventory varies with individuals, most students complete the form in about thirty minutes. If they finish earlier, they should be encouraged to review their responses.

Random Selection of Students

1) Selection of Tenth Grade Students

Place numbers representing the total number of tenth grade students in your school in a container and draw thirty (30) numbers. Then, use these numbers to identify the students from an alphabetically arranged classlist. (If you have only thirty or fewer students in the tenth grade, then all students should be included.) If number two (2) is drawn, the second student on your list would be selected; if number ten (10) is drawn, the tenth student on your list should be selected. Continue the procedure until all students are selected.

2) Selection of Twelfth Grade Students

Use the same procedure as presented above for the tenth grade.

Administration of the Instruments

1) Identify a person to administer the inventory for each grade level.

2) Students at each grade level should all meet together for administration of the inventories.

3) Before you distribute the inventory booklets and answer sheets, have the students count off 1, 2, 3. All 1's should complete Form A; all 2's should complete Form B; all 3's should complete Form C.

4) Distribute inventories and answer sheets.

(over please...)

14) After the students have completed the inventories, the answer sheets should be returned to the Principal.

Returning the Answer Sheets

We would like the answer sheets for both classes to be returned to us in the pre-addressed envelope provided.

Student Reponses

A summary of the student responses for your school will be returned to you within a month after we receive them.

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DIRECTIONS FOR ADMINISTERING ENVIRONMENTAL KNOWLEDGE AND ATTITUDE INVENTORY (FOR REPRESENTATIVE SAMPLES)

Content of Packet

This packet should contain two sets of thirty (30) inventories and two sets of thirty (30) answer sheets. One set is to be used with a representative sample of tenth grade students. One set is to be used with a representative sample of twelfth grade students. Each set of instruments contains ten (10) copies of Form A, ten (10) copies of Form B, and ten (10) copies of Form C.

Time Required to Administer the Inventory

While time to complete the inventory varies with individuals, most students complete the form in about thirty minutes. If they finish earlier, they should be encouraged to review their responses.

Selection of Representative Classes

One tenth grade and one twelfth grade class should be selected to complete the inventories. Each class should be as representative of your school population as possible. We have found this relatively easy to attain at the tenth grade level, but more difficult to attain at the twelfth grade level. Therefore, care in selection of classes becomes increasingly important at grade twelve.

Administration of the Instruments

1) Identify a person to administer the inventory for each grade level.

2) Students at each grade level should all meet together for administration of the inventories.

3) Before you distribute the inventory booklets and answer sheets, have the students count off 1, 2, 3. All 1's should complete Form A; all 2's should complete Form B; all 3's should complete Form C.

4) Distribute inventories and answer sheets.

(over please...)

5) Be certain each student has a No. 2½ or softer pencil.

6) Provide students with information for the population of the community (city, town, etc.) in which the school is located. From the list below, select the number that best describes the location of your school. Give the students the number to mark on their answer sheet in the space for Item 50.

1: Community of 1-1,000
2: Community of 1,000-10,000
3: Community of 10,000-50,000
4: Community of 50,000-100,000
5: Community of 100,000 and over

7) Have the students select the number that best describes the location of their home. Read the descriptions and the numbers to the students. They should place the number on their answer sheet in the space for Item 51. Which best describes the location of your home?

1: Community of 1-1,000
2: Community of 1,000-10,000
3: Community of 10,000-50,000
4: Community of 50,000-100,000
5: Community of 100,000 and over

8) Have the students indicate whether they are tenth or twelfth graders. If they are in grade 10, mark response 1 in the space provided for Item 52. If they are in grade 12, mark response 2 in the space provided for Item 52.

9) Have the students indicate whether they are male or female by marking M or F in space provided under SEX on the form.

10) Have the students indicate their ages by darkening the correct spaces in the first two columns under SECTION NUMBER. If a person is sixteen years old, he would darken 1 in the first column and 6 in the second column.

11) Have the students fill in the school identification number on their answer sheet in the space marked CAMPUS. Your school identification number is _____.

12) Have the students indicate which form they are completing by marking the appropriate space under TEST FORM. Those completing Form A should darken A; those completing Form B should darken B; those completing Form C should darken C.

13) INSTRUCTIONS FOR MARKING THE ANSWER SHEET:

Students should mark the space that corresponds to their answer for each item. The space marked should be completely darkened. If an answer is to be changed, it should be completely erased; wrong answers should not be crossed out. The answer sheets will be scored electronically, so following these directions is very important. For multiple choice items, response a or 1 should be marked in column 1; b or 2 in column 2; c or 3 in column 3; d or 4 in column 4; and e or 5 in column 5.

14) After the students have completed the inventories, the answer sheets should be returned to the Principal.

Returning the Answer Sheets

We would like the answer sheets for both classes to be returned to us in the pre-addressed envelope provided.

Student Reponses

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APPENDIX D

Information Regarding the National Environmental Knowledge and Attitude Survey

The present study is one part of a national survey to assess secondary students' knowledge of and attitudes about the environment. Surveys of other regions of the United States and the District of Columbia are being conducted by Bohl and Rondeau. The Center for Science and Mathematics Education and the ERIC Clearinghouse for Science, Mathematics, and Environmental Education will eventually summarize results of this study and those of the other investigators.

Additional information about this and its related studies may be obtained from:

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